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Forthcoming Events.

JULY (LAST WEEK).

Institution of Mechanical Engineers.—Joint Summer Meeting in England with the American Society of Mechanical Engineers.

AUGUST 2, 3, AND 4.

British Foundrymen's Association.—Annual Convention at Manchester.

SEPTEMBER 27, 28, AND 29.

Iron and Steel Institute.—Autumn Meeting at Buxton, Derbyshire.

NOTES AND COMMENTS.

A Decade of Progress.

Early last month the nation was suddenly plunged into mourning for a Sovereign whose reign, although comparatively brief, has been such as to stand out in brilliant prominence as a reign of peace and progress; for truly may Edward the Peacemaker be said to have placed the indelible stamp of progress on the industrial affairs of the nation. A comparison of the present state of our various industries, and particularly the iron and steel industries, with their position a decade back, forms striking grounds for comment on the effects of a period of peaceful and harmonious international relationship; and those especially who have studied the effects which international conflicts and disturbances in the past have had on the development of home affairs, will appreciate what Great Britain to-day owes to the influence of its late Monarch. Of late years we have witnessed the rise of a new spirit in connection with both home and foreign affairs; the consciousness that efficiency from an industrial standpoint is the true basis of national progress and strength has become more and more influential, until there has set in a steady tide of progress in almost every branch of industry. Not that past years have been without this progressive movement, but too often it has been checked and nullified by disturbed conditions both at home and abroad. Since the close of the South African War, however, despite the depression which inevitably followed, there has been a steady movement towards the better equipment of works, the perfection of manufacturing processes and the general betterment of the conditions under which our industrial operations are carried out. Nor has the foundry been missed in the consideration that has been given to our industries, as those will testify who have benefited from the recent regulations for the improvement in the conditions obtaining in brass foundries. In the iron foundry, too, there have been important developments, particularly as regards the application of moulding machines; for whereas the moulding machine a few years ago was regarded as more or less a speciality, there is now scarcely a foundry of any importance that is not so equipped. Appliances for handling moulds, castings, ladles, and all the bulky articles in works have also largely taken the place of hand labour, and thus greatly facilitated the work of the foundryman. Among other items the perfection of the open-hearth plant for steel work stands out prominently, and although the Bessemer process has declined somewhat, owing to the rise of the open-hearth process, the progress cannot be denied. We have seen, too, the rise of the Talbot steel-making process, the application of dry blast to furnace work and kindred developments, all of which speak of the onward tendency which the iron and steel trades have shown. But perhaps the greatest progress has been in the regard paid to the safety and comfort of the worker, evidenced in the movement for the

prevention of accidents in works. To-day the worker is no longer regarded as a piece of mechanism from whom the maximum of effort must be got for the minimum wage; employers now rather regard their men as intelligent beings co-operating for the better production of the firm's output, and treat them accordingly. The support which such institutions as the British Foundrymen's Association—an institution the founding of which will, of course, be associated with the reign of Edward VII.—receive from employers generally speaks well for the spirit of the age, and forms a marked contrast to the suspicion with which such institutions were once regarded. We have but touched lightly on some of the outstanding features of what has, undoubtedly, been a decade of progress, but in looking forward to the next we need only trust that the progress will be maintained—we see no reason why it should not.

Steel Foundry Possibilities.

It is probable that the next decade will witness greater revolution (or perhaps it would be more correct to say evolution) in steel founding than in any other branch of the foundry trade, and this through the great advances that have been made and are still being made in the construction and operation of electric furnaces. Until quite recently the electric furnace was regarded purely an experimental affair, except so far as the production of special and costly metallurgical products were concerned, and even now there are many who regard it as being far removed from general steel-foundry application. But each year witnesses such progress in the simplifying of electric refining processes, such advances towards the perfecting of electric power plant, that to many enthusiasts the application of electricity to steel founding on a general and commercial scale appears within measurable distance. It is, of course, well known that a number of installations have for some time been turning out steel castings from these furnaces, but these have been either installations in the vicinity of cheap power—as, for instance, in close proximity to waterfalls or similar forces that can be economically converted into electric power—or furnaces worked only for the production of special steels. In this country the factor which has hitherto hampered, and which will probably for some time restrict, the adoption of the electric furnace is the cost of electric power. In many directions the use of electricity has made striking headway, as in cases where exhaust steam has been utilised to drive turbines for the production of electric power, until there is scarcely a branch of engineering that has not been invaded by it. But in most foundry plants there are not available the means for this cheap production of electric power which exist in so many other manufacturing plants. A foundry desiring to run on electricity has usually no exhaust steam to apply in the direction mentioned, and while the utilisation of blast-furnace gases has proved a very economical means of producing power, unless the foundry in question is run in connection with a blast-furnace plant, which is not often the case, this means is not available. Consequently, recourse must be had to the supply from some electric power company, unless gas-engines, steam-power plant, or some such installation is run for the production of the electrical energy, in which case the cost is at once raised to a point approaching prohibition, when taken in conjunction with the cost of installing electric furnaces in place of existing ones.

Some Advantages of the Electric Furnace.

There are advantages associated with the use of the electric furnace which have been realised and acknowledged all along, and amongst these may be mentioned the possibility of more accurately controlling the progress of the re-actions which take place during refining. This feature, as will be readily recognised, is of considerable value where steels of definite composition are to be produced, and results from the fact that, as in no other class of furnace, the influences of fuel and blast have not to be considered. The only influence introduced for the purpose of melting is that of heat, there being practically no variable and uncontrolled elements present. Any materials introduced to produce the refining reaction, of course, are not to be considered on the same basis as the elements which are introduced with gas, oil, or other fuel, and air or similar blast. Another advantage of some designs of electric furnaces, though not associated with all, is that the charge may be in practically any form—cold pig, scrap, turnings, &c., or molten metal—as found most convenient. These and other features have been so well appreciated by our leading steel makers that a number of them have installed electric furnaces to deal with at least part of their steel foundry work. This does not mean that other furnaces are to be regarded as secondary in efficiency and economy, for local conditions would often rule out the adoption of the electric furnace, while the open-hearth furnace would be quite applicable. The latter has generally been regarded as the most suitable and economical furnace of all existing types for large work, and it has been developed to such a stage of efficiency through the perfection of systems of regenerating the gases used for heating, that it will probably hold its own for many years yet. But the cost factor, combined with the demand for increased strength in the steel, is continually causing fresh changes and developments (as witness the adoption of the "duplex" process in many American works, which process employs both the converter and the open-hearth), and it would be a matter for no great surprise were the electric furnace to prove, in the course of the next few years, a powerful rival to the open-hearth furnace.

Some Hindrances.

Should there, however, be any marked change from the open-hearth to the electric furnace, the change would necessarily be a gradual one, for the cost of installing plant of an entirely different class would be heavy, and only the larger concerns would, for a time, be in a position to effect the alteration. Another point is that, while the open-hearth has reached a stage of development which is generally approved and accepted, the electric furnace exists in a number of distinct forms and varieties, each with some special feature claimed for it and each with its own advocate in the metallurgical world. Consequently, when the steel founder inquires as to the suitability of electric furnaces for his work, he finds experts split up into a number of different and often quite hostile camps, and even though he fixes on what is acknowledged to be a good furnace, he finds a number of eminent authorities each prepared to recommend something different. So until practical application under various conditions has effectively proved the applicability of a comparatively simple form of electric furnace, existing types will continue to hold their sway. As a final feature operating against the ready adoption of any new style of plant may be given the inherent dislike of change which appears to be one of our national characteristics. We have many stalwart bands of

progressives in our industrial circles, but, generally speaking, we are inclined to be over partial to the ways of our fathers—because they were the ways of our fathers.

Are You Requiring Analyses of Your Metals?

Owing to the number of samples of iron and other metals which are from time to time received by the editor from readers who desire to know the analyses or to obtain other information on the metals, it has been deemed advisable to make more comprehensive arrangements for dealing with these enquiries. We have, therefore, made special arrangements with a responsible firm of analytical and metallurgical chemists to analyse any samples addressed to this office, and readers desiring to have analytical work done will have their requirements met at very reasonable terms. The charge for the determination of each constituent in iron and steel, alloys, metallurgical products, etc., will be 6s. 6d., and for the determination of the five elements—carbon, silicon, sulphur, phosphorus, and manganese, the charge will be 25s. Readers will thus be able, at a very small expense, to obtain analyses of any metallurgical product, and so make full investigations in connection with the metals they are handling. We would stipulate, however, since this offer is made only to subscribers of the FOUNDRY TRADE JOURNAL, that the name of the agent through which the journal is supplied be stated, unless the reader is a direct subscriber to this office, and accordingly on our lists.

The Value and Defects of Aluminium Zinc Alloys for Casting.

Although recent researches have indicated the exceptional and valuable properties of the aluminium alloys containing copper as the hardening element, zinc still finds considerable popularity for this, largely on account of its comparative cheapness. Where lightness is of only secondary importance, or it is not necessary to retain practically the original lightness of aluminium, zinc is frequently used, and the combination gives an alloy of considerable strength, which is harder and more fusible than aluminium alone. With zinc present up to 18 per cent., a fairly ductile alloy is obtained, and an increase of the zinc contents to 25 per cent. gives a good casting alloy. When the zinc is increased to materially over 25 per cent.—say 30 to 35 per cent.—an extremely hard effect is produced, which, however, militates against the use of the alloy for many purposes where working and machining have to be done. In addition to this, of course, the lightness of the aluminium is sacrificed to a considerable extent. But while the aluminium-zinc alloys are of considerable value, the foundryman often experiences a deal of trouble in getting sound castings therefrom. In fact, the majority of the troubles of the aluminium founder may be traced to the use of zinc. Owing to the large amount of shrinkage which castings of this mixture have in cooling, and the comparatively weak nature of the alloy when hot, unless the founder thoroughly understands his business, the loss through cracked castings will far out-weigh any saving secured through the cheapness of zinc. Many founders, however, do not understand this, and fly to zinc as a cheap constituent, which, being much heavier than the aluminium, and consequently increasing the weight of the castings sold, considerably cheapens the mixture per pound; and when they find their castings failing, and showing defects in the machine shop, blame the moulder, the melter, and anyone else handy. The chief essential in dealing with these alloys is to provide for the plentiful accommodation of the shrinkage. In the case of many castings this can be done, and it is then quite possible and comparatively easy to get good results; but there are other cases in which this can not be done, and no amount of attention to melting will prevent the development of cracks. This is an inevitable, though very unfortunate, feature of the aluminium-zinc alloys, for otherwise the results obtained are excellent. The use of zinc gives clean, good castings, free from pinholes and other defects, excepting those mentioned which result from shrinkage. But as these shrinkage cracks may develop only after a good deal of machining has been done, the matter assumes a serious aspect. Shrinkage cracks, as any practical foundryman will understand, are simply the result of the stresses set up during cooling, and are analogous to the cracks which develop in iron castings through the contraction of the metal during cooling, and as in the case of some iron castings, the faults may only become apparent on the article being machined or subjected to some extra stress. It will be seen, then, that if the form of an aluminium casting is such that free allowance cannot be made for the shrinkage, it is far better to avoid the use of zinc, and employ a small amount of copper, disregarding the question of the first cost of the metals. On the other hand, there are many purposes for which the aluminium-zinc alloys are quite suitable, and it would be quite unfair to condemn them wholesale. Excellent results can be got by a combination of these two metals as regards tensile strength and elongation, for it has been demonstrated that 80 per cent. aluminium and 20 per cent. zinc will give a particularly strong alloy, with a specific gravity of about 3.5.

British Foundrymen's Association: Lancashire Branch.

The annual meeting of the Lancashire Branch of the British Foundrymen's Association was held on Saturday, May 7, in the School of Technology, Manchester, Mr. R. W. Kenyon presiding. Before commencing the business of the day the President alluded to the death of the King in sympathetic terms, the members endorsing the President's remarks by rising in silence. The Secretary's report having been read and adopted, the election of officers was proceeded with, when the following appointments were made:—President, Mr. R. W. Kenyon; Vice-President, Mr. G. Buchanan; Committee, Messrs. D. Cordingley, J. J. Chipchase and F. Critchley, elected to the vacancies caused by the retiral (as per rule) of Messrs. T. W. Holt, H. S. Skelton, and J. Kenyon; Hon. Secretary, Mr. H. Sherburn, Rotherwood, Stockton Heath, Warrington.

The local committee for making the arrangements for the annual Convention to be held in Manchester in August, is made up as follows:—Mr. R. W. Kenyon, Professor H. C. H. Carpenter, Messrs. E. L. Rhead, C. A. Edwards, W. Smalley, G. Mills Palmer, A. Leidig, G. Buchanan, W. H. Sherburn, J. Simkiss, J. Penlington, W. Wright, T. W. Markland, D. Cordingley, J. J. Chipchase, F. Critchley, T. W. Holt, J. Kenyon, H. S. Skelton, J. H. Kain, and H. Sherburn. The urgent business having been transacted, it was unanimously decided, owing to the death of the King, to close the meeting.

The Working of a Cupola.

By S. H. Chase.

Few of the articles on cupolas and cupola practice deal with the truly practical and working parts of the furnace. By the working parts is meant the sand bottom, the spout and spout lining, the front and tap hole and the fettling door. It is extremely interesting to trace the various processes that go towards the making up of these important parts of the furnace when preparing for the day's work.

The first duty of the cupola attendant when he arrives in the morning is to chip out his furnace and clean away, as far as he is able and it is practicable, all the slag which accumulates in the melting zone and especially just above the tuyeres. To do this, if the furnace is anything like a large one and has a stationary bottom, he squeezes through the opening which is called the fettling door at the bottom of the cupola and stands on the bottom of the furnace. This opening is directly opposite the front or tap hole, and is used, as will be explained later, for making up the front and tap hole. He takes inside with him a hammer and a fairly long-headed chisel, and as gently as possible chips away the slag until the lining assumes

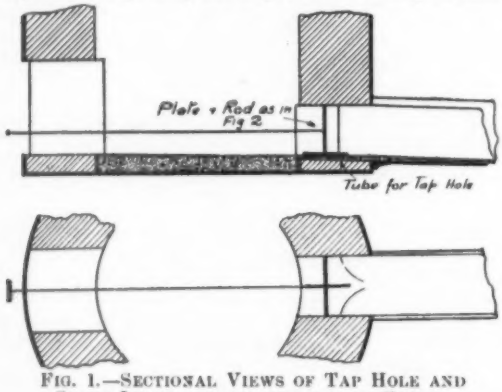


FIG. 1.—SECTIONAL VIEWS OF TAP HOLE AND SPOUT LINING BEFORE PUTTING IN FRONT.

approximately its original shape. All lumps that are at all likely to interfere with the melting should be removed, but care must be exercised not to disturb the lining in any way.

Having removed as much as possible he now sweeps out the dust and chippings from the bottom and prepares to daub the lining to fill up the holes and weak places that occur from day to day. This daubing is usually composed of ground gannister and water mixed so that it looks not unlike mortar. The method of putting it on is to take a handful and actually throw it at the hole which requires to be filled up and then just pat it down with the back of the hand and smooth it over. The cupola attendant goes right round the furnace until the lining looks smooth and clean.

When a complete new lining has been placed in a cupola, after a few weeks a hollow kind of ring will begin to appear in the lining at the melting zone, where it has worn away owing to the intense heat. It is not necessary to completely straighten out this hollow or belly when daubing up, as it has been found that the furnace melts better when there is this hollow; but, on the other hand, the lining must not be allowed to get too thin at this zone, as there is a risk of burning through. The main object in view, when chipping out and daubing, should be to prevent any possibility of the charges hanging up or of the hot metal running into the tuyeres, which it is likely to do unless the slag just above them is cleared completely away.

The furnaceman now turns his attention to the spout, which undergoes, in a similar though minor degree, the same process that the lining went through. All the scrap and burnt lining is scraped where necessary, and then the main part which is left is damped and made ready for making up. The spout may be lined with ordinary moulding-sand, loam or blue clays mixed with sand or gannister carefully ground. Gannister makes one of the best, as it does not crumble and break up too readily when the spout is being re-made up.

Before finishing off the spout, the sand bottom, in the case of a drop bottom cupola, has to be made up, and a remark or two about this process may be added. It is extremely important that every care should be

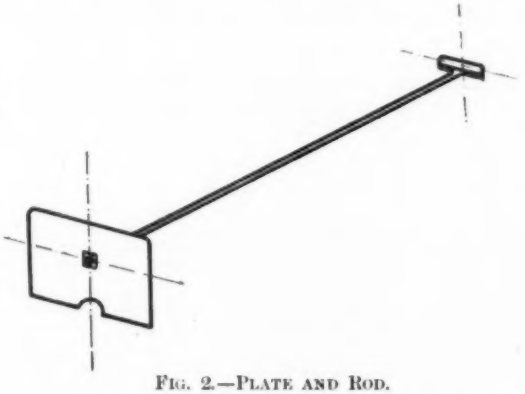


FIG. 2.—PLATE AND ROD.

taken over this to prevent the iron getting through the doors. After the doors are set in place, which is most easily done by means of a prop, a layer of sand several inches thick is placed upon them to form the bottom. This sand has to be of the particular quality that will resist the action of the metal, not melt, but drop easily when the doors are dropped at the end of the heat. The doors are sprinkled first, however, with water and then the sand is placed upon them and well packed round the edges to secure a tight joint, and then rammed well over the bottom until it reaches the right depth, which is from 3 in. to 6 in., dependent upon the size and diameter of the cupola. Usually a slight slope towards the tap hole is made. The bottom is then slushed over with a bucket of clay wash to make a smooth, hard surface. The bottom of the stationary bottom cupola is composed usually of several inches of gannister upon the bottom plate and this merely requires to be brushed out after the lining has been chipped out as it sets hard and is permanent, as the name implies. The bottom having been dealt with, we may now go back

to the spout. A perfect joint should be made between the sand bottom and the spout lining bottom. This should be about 2 in. thick if the spout has the right slope, which should be a gradual one from the tap hole. The sides are built up full at the bottom so as to leave only a narrow groove in the middle and to keep the stream in one place. The lining is sometimes finished off with a layer of loam and then the whole is smoothed over with a damp brush, while to give a good finish a coating of blacking is sometimes put on.

To form the tap hole and front, the gannister of the spout lining is carried about 6 in. into the square opening of the shell, and it is then curved over on both sides so as to form a kind of wedge (see Fig. 1). A square iron plate on the end of a long rod is now pushed in from the opening at the back until it is within 6 in. to 8 in. of the outside of the shell, and consequently nearly up to the point where the spout lining ends. It is then wedged in position. The hollow between the outside of the shell and the iron plate is now filled up with the sand left over from making up the bottom, or a mixture of Mansfield and Worksop sand, the iron plate being used as a background on which to ram the sand. Before doing so, however, a round piece of iron tubing (having the same diameter as the tap hole is required to be) is placed in the middle of the opening and in a line with the centre of the spout, with one end of the tube against the circular hole seen in the plate (Fig. 2).

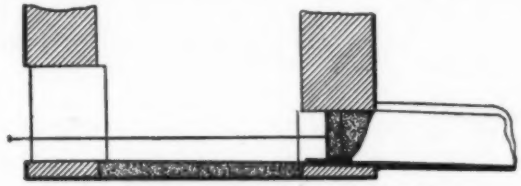


FIG. 3.—SECTION OF TAP HOLE AFTER FRONT HAS BEEN PUT IN.

The sand is now rammed tightly and then cut away round the iron rod from the top until it assumes a shape something similar to a heart, and arranged so that there is only from 3 in. to 4 in. length of actual hole (Fig. 3). The reason for this precaution is that the iron in a long tubular hole of an inch or so in diameter would solidify between the taps out and cause an infinite amount of trouble. The iron tube and plate are removed, and the tap hole finished off, slightly damping it if necessary.

Back Door or Breast Plate Hole.

Having finished the front part of the furnace the back door, or breast-plate hole, is now wedged up with large lumps of coke and then sufficient shavings to set the bed alight are thrown in from the charging door, and on top of these the amount of coke that is necessary to form the bed. A basketful or two is left over to allow for any uneven setting when it has burnt up. The amount of coke required for the bed is found out by experience, and is that amount which brings the top of the bed just up to the melting zone. This bed is an extremely important feature, owing to the fact that it is on the top of this that all the actual melting takes place.

Various statements have been made and theories been held out to explain accurately where the melting zone is, and briefly, although one cannot say definitely, this point or region is some few inches above the tuyeres. It is necessary to experiment and find out where this zone is in any particular cupola, by varying the amount of coke used on the bed and also varying the charges. Of course, the position and number of tuyere openings largely affect this, and numerous experiments have been made with tuyeres at various heights and blasts at different pressures to ascertain whether this is a movable and extensible zone or not. The object of the higher tuyeres is to heat up the iron as it gradually falls down the furnace, but as far as can be ascertained, these do not lengthen the zone to any great extent, while the different pressures of blast merely shift the zone up and down. If too much coke is put on the bed the iron above cannot be melted until the superfluous coke has burnt away to allow the iron to settle in the zone. If the charge of coke is too heavy, the effect is exaggerated, with the result that there is a stoppage at the end of each charge, whereas if the charge of iron is too heavy the bed sinks so low that after a time the iron melted becomes dull, and in a short time melting ceases altogether.

The charges of iron and coke must therefore be so arranged that as each charge of iron melts, the coke on top of it will settle down on the bed, some of

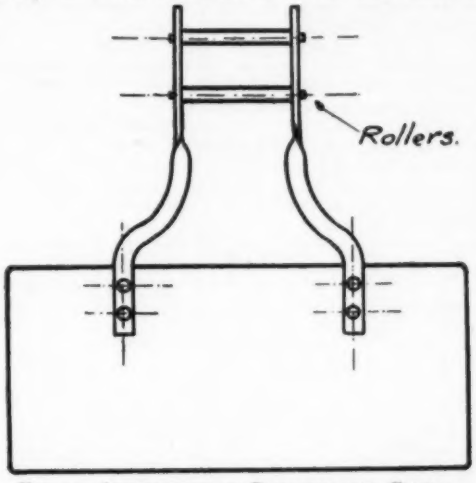


FIG. 4.—APRON USED IN DUMPING THE CUPOLA.

which will have burned away and just bring the top of the bed to its former level. Unless this is done iron of uneven quality and heat and a moving melting zone will result.

Lighting Up.

Having formed the bed a light is now applied to the shavings at the cupola bottom in order to set fire to the bed. When the fire is seen breaking through the top of the bed, which will take anything between half an hour and two hours, dependent on the size of the furnace, it is time to commence charging.

After the fire has burnt up, the fettling door or breast-plate door is packed up with sand to prevent any iron from running out. On the bottom plate and some few inches away from the coke that has been wedged in position in the opening, a small iron rod is placed lengthways between two lumps of coke before the sand is rammed up. The reason for doing this will be explained later on. Ordinary floor sand may be used for packing this door up, although it must be fairly damp. Round the edges must be rammed hard, and the cover then placed upon the lugs and wedged up. Cupolas with a reservoir have two of these to be done. The bottom of the reservoir is first well covered with charcoal in order to warm it up thoroughly and

to keep the first iron hot. This floats on the top of the iron and comes off with the slag.

Charging.

The method of charging is, as has been explained before, to place the fuel in layers, a charge of iron on top of a charge of coke, while the proportion has to be found out by experiment. The amount of the charges vary with the size of the cupola and the work that has to be poured. As the iron gets to the end of the melt, less coke is necessary, and the charge is decreased accordingly. The pig should be broken into small pieces and the scrap broken up small. The cupola is charged up to the charging door before the blast goes on, and kept up to that level as far as possible until all the iron to be melted has been put on.

A charge of ordinary iron is usually put on first, which warms up the furnace and prepares it for the special iron which comes after it. This iron is generally used for pouring heavy work, as it is somewhat dull. Usually the first charge of iron is somewhat heavier than the subsequent charges, and the greater the weight of the first charge of iron in proportion to the weight of the bed the better the average will be in melting. The amount of coke used, including that used on the bed, should work out about 2 cwts. per ton of iron melted.

After a number of charges have been placed in the furnace a charge of limestone is thrown on the top of the coke. This melts and forms a fluid slag which absorbs the ash of the fuel and dirt and sand from the iron, and carries them to the bottom, where the whole lot is drawn off as slag. A few handfuls of limestone are generally placed on top of each subsequent charge of coke until the end of the heat. Free use of limestone causes a clean dump and brittle slag which is easily chipped out.

Blast and Blowers.

When the blast is put on there is a rush of hot air from the tap hole, which serves to dry sufficiently the whole length of the spout. If necessary the front and tap hole may be previously dried by placing some hot coke in the spout just in front. In a reservoir cupola the blast is stopped a few minutes after putting on, and the tap hole closed at the lining end, by pushing some sand lightly down the hole and lightly ramming it up. This is to prevent the first iron solidifying in the tap hole. The blast is then put on again, and in a few minutes iron can be seen trickling down into the reservoir. In the ordinary cupola the tap hole is left open until the iron melts and runs hot from it. The first iron is used to warm up the ladles, and is then poured into the pig bed.

The blowers used for cupola work are of practically two designs—the rotary pressure blower and the fan blower, although the former is, perhaps, more economical, owing to its positive action. Both types act extremely well. The Roots blower is a good example of the rotary pressure blower and the Sturtevant fan of the fan type. The pressure of the blast depends on the amount of air it is necessary to get into the furnace and the area of the tuyeres.

The operations of tapping out and plugging up require considerable skill if burns are to be avoided. For tapping out, a bar about 2 ft. or so long and flattened out for about 9 in. from the end, which is pointed, is used, while for plugging up a cone-shaped bod of clay is jammed on to a rod with a flat end about 1½ in. in diameter, and then rammed into the tap hole.

Dumping.

At the conclusion of the melt the blast is shut off and any surplus iron that may be left in the cupola is run off into the pig bed. An experienced manager will rarely have much left over, as the amount of iron required is calculated day by day, and this amount only is put into the furnace. The tap hole is then closed and the bottom breast-plate taken off. The sand is scraped away round the small piece of bar iron mentioned before, which is then withdrawn. A long piece of round bar is now pushed through the hole which was occupied by the small piece and a hole made right into the interior of the furnace. Any iron that is left in now runs out into the beds made to receive it through this hole. When slag is seen issuing from the hole it is stuffed up and preparations made for slagging.

A kind of apron (Fig. 4) is now fixed about two yards from the shell to prevent the slag flying all over the place and to assist in raking out. The whole of the coke front is now knocked out and the slag runs out, a path being made so that it does not run over or into the beds made for the pig-iron that has just come out. The bed and the remaining slag is then raked out. Long rakes are used, and these are supported on the rollers seen in Fig. 4. The furnace is then left until the morning, when it is cool enough to be chipped out.

In a drop bottom cupola, as the name implies, the bottom is dropped as soon as the melted iron is drawn off, and this arrangement simplifies the work of dumping to a large extent. The smaller ones, however, are liable to bridge in spite of careful charging, and when they do, they require nearly as much work upon them as the stationary bottom, if not more. Water is poured on the slag as it comes out to deaden it and make it ready for removal the next morning.

ANGLO-JAPANESE STEEL FOUNDRY AT MURORAN.—Mr. E. F. Crowe, the British Commercial Attaché at Yokohama, has forwarded particulars relative to the steel foundry at Muroran, which is a joint undertaking, half of the capital having been supplied by a Japanese company and the other half by two British companies. The object of the company is the manufacture of guns and ammunition for the Japanese army and navy, and also of railway carriage wheels and axles and various kinds of steel manufactures. The coal and coke required will probably be purchased from a Japanese company which owns collieries and coke ovens within a few hours by rail of Muroran. Manganese can be obtained from the mines in the neighbourhood. The problem of obtaining pig-iron is one which presents more difficulty. At first it was thought that Swedish and Spanish products would be used. Experiments are now being carried on, however, in Japan, with a view to the utilisation of the enormous quantities of iron sand along the shore of Volcano Bay; but, before the sand can be made into pig-iron, it has to be mixed with other ores and briquetted. The Abuta iron mine is not far from Muroran, but the deposits of ore are not very extensive and would not suffice for the requirements of more than the first few years. In the neighbouring district of Kutchan, however, there are large quantities of a similar ore which might be utilised. The buildings provided for in the plans of the foundry include two machine shops, a forging shop, tempering and shrinking shop, pattern shop, smith and hammer shop, power house, foundry, gas producer, laboratory and test room, drawing and document room. Mr. Crowe adds that it is unlikely that the foundry will be in working order before next July at the earliest.

The Girod Electric Furnace for Steel Castings.

In our issue of March, 1909, we presented an illustrated description of the Girod electric furnace for the production of steel for castings, etc. This furnace, it will be remembered, is classed among the arc furnaces, but it also operates in part by means of resistances to the passage of the current through the metallic mass, which feature is of considerable importance at the commencement of the operation, when the current is directed upon the cold charge of scrap, pig-iron, etc.

Since its introduction the Girod furnace has been accepted with considerable favour, and at the recent London meeting of the Iron and Steel Institute a Paper treating with the furnace was read by Mr. W. Borchers, of Aix-la-Chapelle. We present herewith an abstract of the Paper, together with illustrations of various installations:—

Our knowledge of the qualities of materials for building electric furnaces, and of the constituents of the furnace charges, especially as far as their conductivity at high temperatures is concerned, as well as in regard to their chemical affinity towards one another at high temperatures, is, in spite of all scientific progress, far from being complete; and from that

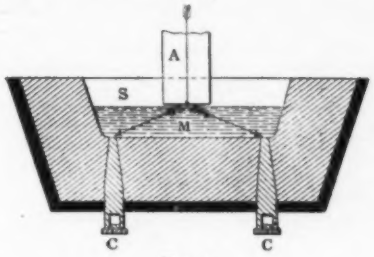


FIG. 1.

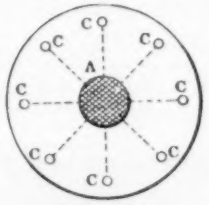


FIG. 2.

FIGS. 1 AND 2.—SECTIONAL ELEVATION AND PLAN OF GIROD FURNACE HEARTH, SHOWING DISTRIBUTION OF CURRENT THROUGH THE MOLTEN METAL.

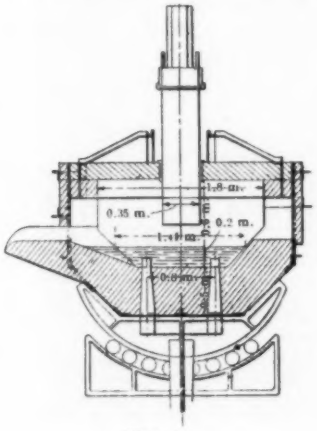


FIG. 3.

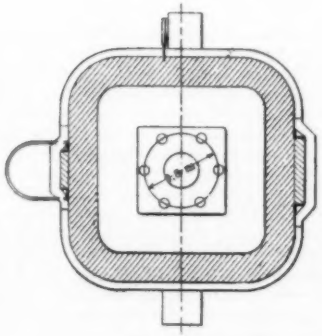


FIG. 4.

FIGS. 3, 4 AND 5.—SECTIONAL SIDE ELEVATION AND PLAN AND FRONT VIEW OF 2½-TON GIROD FURNACE.

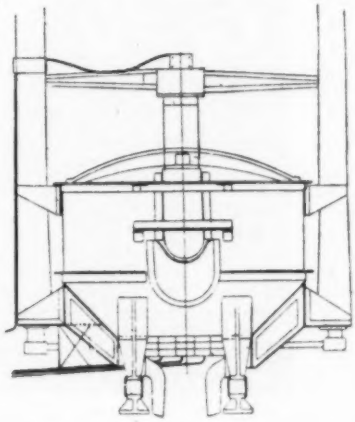


FIG. 5.

it may be deducted that the smaller the number of unreliable factors for the construction and for the running of such furnaces the better.

This very natural deduction deserves special attention when an electric furnace for steel-making has to be chosen from the constantly growing number of inventions; for the chief constituent of steel, the element of iron, is a substance which, in its liquid state, has so great an affinity for those elements which are to be removed from the charge, that it is very difficult to comply with the following conditions:—(1) To heat the refining slag to the highest point of its chemical activity; (2) to prevent the iron from participating in these reactions, or, where this cannot be prevented, to make it participate in those reactions so that it finally appears in the end product without material losses; (3) to select and arrange the materials from which the furnace is to be built, so that wherever their contact with the furnace charge cannot be avoided, their nature shall be such

as not to react upon the constituents of the charge in an injurious way.

The Girod furnace is the simplest of modern electric steel furnaces, both as an experimental furnace, or as a smelting works furnace on the largest scale possible. In the author's laboratory it is being used with currents of 30 to 36 kilowatts, while elsewhere, for steel smelting, it is being used with currents of 360 to 1,200 kilowatts. It is a combination of a resistance and an arc-heating furnace. The metal to be smelted serves as one of the electrodes; it is covered by the refining slag as an electrolytic conductor, while a carbon block (or several blocks), introduced from above through the cover of the furnace, forms the opposite electrode above the centre of the bath. The arcs play between the carbon blocks and the slag, and no doubt here the largest amount of heat is produced. A second heat-producing zone is the layer of slag through which the current passes to and from the metal. Last, but not least, the metal itself becomes an important source of heat on the current traversing the centrally hanging carbon rod or rods radially to and from the periphery of the bath. This is important not only for uniformly heating the bath, but also for keeping every part of the liquid metal in constant motion. In running a furnace with as high a current density as is found necessary to melt iron and steel, it can easily be observed that the passage and the transformation of the electric current into heat is accompanied by violent mechanical motion of all particles of the liquid. This movement, however, accelerates the contact between the impurities of the iron and the refining slag floating on top of the bath. The Girod system of arranging the electrodes and contacts is a safeguard against any stagnation of parts of the liquid furnace charge, and for this reason the advantages of the induction or transformer furnaces and of electrode furnaces are combined in the Girod furnace, while the imperfections of both forms have been overcome.

The peculiar arrangement of electrodes and contacts gives the Girod furnace a special advantage

FIG. 6.—2½-TON FURNACE AT UGINE.

account of the effective manner in which the electric current is made to pass through the molten metallic body, and this is the most important feature of the Girod process. The distribution of the electric current through the molten metal is clearly shown in Figs. 1 and 2, in which the letters indicate—A the carbon electrode, S the slag, M the molten metal, C contact pieces to connect the metal with the current conductor. These contact pieces are of such cross section and length that every one of them will take up only a certain part of the whole current without being overheated, and therefore without excessively increasing its resistance. An additional regulation of the temperature and resistance of each contact piece is effected by cooling the ends of these bodies, which contain small chambers, by means of circulating water. These bodies, which are made of pure iron to avoid any deterioration of the furnace charge, are therefore not only the conductors between the furnace charge and the current generators, but serve also to ensure regular and uniform distribution of

over other electrode furnaces when cold scrap is to be melted. As soon as possible after charging the hearth of the furnace the upper electrode is lowered until it rests upon the heap of scrap, and the current is compelled to pass by means of numerous small arcs through the whole mass of scrap to the periphery of the heap on the hearth bottom. The heap breaks down simultaneously in all parts in a very short time, and there is no sticking of cold pieces to the bottom of the furnace, and no necessity for stirring up and loosening such lumps from the hearth and endangering the latter.

The applicability of the Girod furnace is in no way restricted by the nature of the raw materials. It may be fed with cold scrap or with molten metal. When feeding cold scrap the whole charge is not put in at one time. After the large part of the charge has been shovelled or otherwise thrown upon the hearth, the current is sent through the heap in the manner already described. The rest of the charge is put into the furnace together with the first batch of

the refining ingredients. Taking a 2-ton furnace as an example, the charge consists of 2,000 to 2,500 kilogrammes of iron scrap, and the first batch of flux usually consists of about 80 kilogrammes of lime and 220 to 250 kilogrammes of iron oxide in the form of ore, which, with the iron oxide that covers the scrap, serves as an oxidising agent. The melting of the iron charge and of the first batch of refining flux requires four and a half to five hours. On the slag becoming exhausted of iron oxide, and, therefore, of its oxidising power, samples of the bath are taken and tested to ascertain the degree of refining of the molten metal. According to the degree of purification the furnace now receives (of course after the first slag has been skimmed off) a second, and if necessary a third batch of lime and iron oxide. After the removal of the last slag the surface of the metal bath is thoroughly cleansed by throwing in about 30 to 40 kilogrammes of lime and skimming this off after a while. The further treatment of the iron bath depends upon the presence or absence of impurities which could not be removed by the lime-iron oxide refining and upon the quality of steel to be produced. According to these circumstances, deoxidising or otherwise refining agents are employed, such as ferro-mangano-silicon, ferro-aluminium-silicon, ferro-mangano-aluminium silicon, and other alloys. For producing carbon steels an addition of Swedish charcoal iron or of a kind of iron very rich in carbon, made in a separate electric furnace of the steel works, can be made.

The final step in the production of special steels is the addition, after these refining operations, of iron alloys with metals like nickel, tungsten, and chromium.

The total duration of one melting operation from the starting of the current to the casting of the finished product into ingots or moulds covers about eight hours, assuming that the raw material is not pure. Pure raw material, of course, will require less time and less power.

The smaller of the two types of furnaces used in steel works are run with alternating currents of about 300 kilowatts at about 60 to 65 volts. The larger furnaces require 1,000 to 1,200 kilowatts at 70 to 75 volts. Taking into account a loss of 10 to 11 per cent. of the charge by oxidation and evaporation, the power required to make one ton of steel in a small furnace is 900 to 1,000 kilowatt-hours, and in a large furnace 800 to 900 kilowatt-hours.

The consumption of carbon electrodes amounts to 12 or 15 kilogrammes per ton of steel, including the short pieces which remain in the holders, when the latter have reached the lowest point at which they can withstand the radiating heat of the bath.

The lining of the furnaces, mostly consisting of calcined dolomite, will withstand at least 80 charges. Thereafter the side walls, into which cavities have been eaten by the slag around the level of the molten bath, will require repairing, and these repairs will subsequently need to be effected at shorter intervals. The bottom of the furnace will, however, stand 120 to 160 charges without repair. The thickness of the bottom will have by then been reduced by about 100 millimetres. Furnace linings will stand a considerably longer time if liquid charges are used. One furnace working in this manner was run for 200 charges without any repairs. The linings of the furnace covers require more frequent renewal. In the small furnaces they need repairs after 25 to 30 charges, and in the larger furnaces after 20 to 25 charges. The other parts of the furnace are not worn out as fast as the linings and electrodes. The furnaces which have so far been put into operation still possess their original outfit.

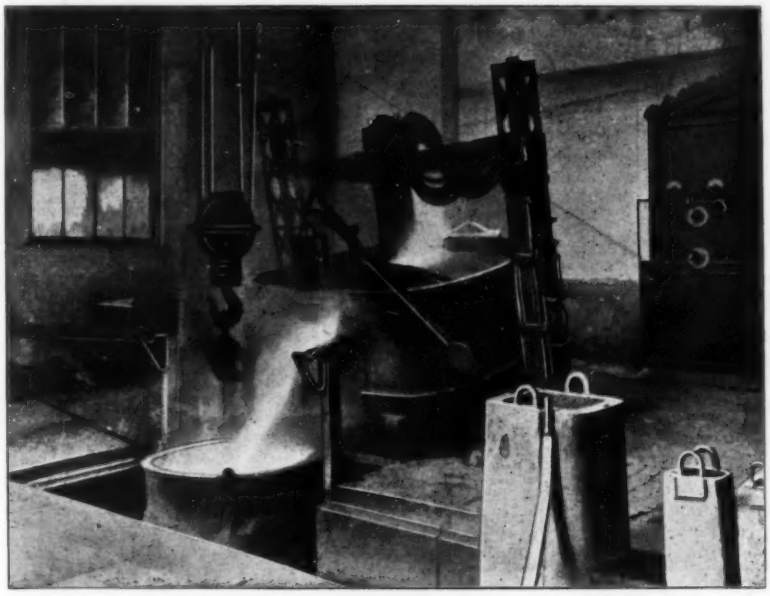


FIG. 7.—2½-TON FURNACE AT SERAING, BELGIUM (SOCIÉTÉ JOHN COCKERILL).

The costs of the different types of Girod furnaces and of complete plants are as follows:—

A small 2½-ton furnace, including regulators for the electrodes, measuring instruments, tilting device mechanism, and the conductors from the furnace to a dynamo or transformer near the furnace-room, costs about £600.

A large 12½-ton furnace with a similar outfit will cost about £1,200.

The manufacturing costs of the electrodes amount to about 2s. 6d. to 3s. 6d. per ton of carbon body.

A complete plant with one 2½-ton furnace for regular running and one furnace for reserve, and with all appliances and melting-house, but without dynamo or transformer, will cost approximately £8,000 to £12,000; and a plant working with a large 12½-ton furnace, £12,000 to £16,000.

Aluminium Gas-Engine Cylinders.

The demand for light-weight gas engines for motor boats, automobiles, and flying machines has led to the extensive use of aluminium in the construction of these motors. Cylinder heads, pipes, frames, etc., are now cast of this metal, but for many years efforts to substitute aluminium for grey iron for the cylinder have not been attended with success, as the metal wears away rapidly as the result of the piston travel, and good compression cannot be maintained. Efforts were made to insert grey iron liners in aluminium cylinders, which were made about ½ inch over-size and were reduced to the proper dimensions by the cast-iron sleeve for the piston travel. As it was found impossible to obtain a perfect fit of the liner to the cylinder under all conditions, chiefly due to the variations in the shrinkage of the two metals, these experiments were not marked with success. The problem has, however, been taken up again by Mr. E. C. Ewen, president and general manager of the General Machinery Co., Bath City, Mich., U.S.A., who maintained that an aluminium cylinder lined with a stronger metal for piston travel and wear, was not among the impossibilities of gas engine construction. It was his theory that the best method of joining a wear-resisting liner to the aluminium cylinder was to cast the aluminium on to the grey iron liner, and after many trials this has been successfully accomplished. It was found to be entirely a foundry problem, with the difference in the shrinkage of the two metals as the chief difficulty to be overcome. Up to 24 cylinders in one week have now been turned out without a single loss. As an example of this class of work may be taken a four-cylinder, two-cycle gas engine, built entirely of aluminium, with the exception of the flywheel and the cylinder liners. This motor, not including the flywheel, weighed 400 lbs., as against 710 lbs. when made of grey iron. The intake pipe of the cast-iron engine was made of brass, and the exhaust pipe was grey iron, while in the lighter motor both were cast of aluminium. The aluminium cylinders have been subjected to every conceivable service test to ascertain whether a separation of the metals would be possible after continued operation. The engines have been run hot until nearly stalled, ice water being then pumped into the water jacket without effecting a separation of the aluminium and the iron. The engines have also been operated with the circulating-water system cut off, and they have been jarred severely while running hot, without affecting the liners of the cylinders. To equalise the shrinkage of the two metals as far as possible when casting, the liner is heated with a blow-torch immediately before it is set in the mould and just before the aluminium is cast. Further, the aluminium is poured as cold as possible and yet at such a temperature to insure its running into all parts of the mould. It is claimed that these expansive iron liners, which absorb a large part of the heat of the explosions in the cylinders, correspond in exact co-efficience with the more expansive aluminium, which is heated by radiation from the liners, and is cooled by the water circulating in the water jacket. A standard aluminium alloy is used, containing aluminium, 92 per cent., copper 8 per cent., and a small amount of nickel. The cylinder is cast in a horizontal position, risers being provided at the base of the cylinder, with an overflow at the top of the cylinder, so as to insure the flow of aluminium around the cast-iron liner and to provide ample metal for shrinkage.

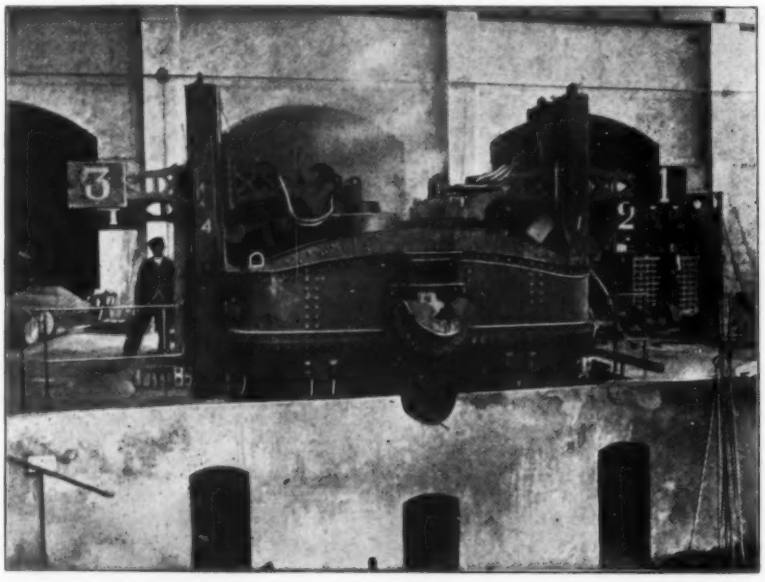


FIG. 8.—12½-TON FURNACE AT UGINE IN OPERATION.

Magnesium as a Deoxidiser in the Brass Foundry.

Since 1829, when Bussy first obtained magnesium in its coherent condition, that metal has become familiar to many foundrymen acquainted with the casting of aluminium, though its properties and value in the foundry in other directions are probably not so well understood. Under the title of "magnalium" alloys of aluminium and magnesium (the latter generally ranging from 1.5 to about 1.6 per cent.) with small amounts of copper, nickel, tin, lead, etc., have been prepared for a number of commercial purposes, though the cost of magnesium militates against the use of the metal for general purposes. But while the cost is too high to allow the liberal use of magnesium in alloys, there is another opening for it in the hands of the brass founder. As a deoxidiser it possesses excellent properties, and has been found to greatly improve the quality and strength of the copper alloys. In the melting of scrap brass gates and sprues, chips, filings, etc., it is almost invaluable. The amount required, too, is not great, 0.05 per cent. serving to greatly improve the metal. This amount, added to melted chips, filings, etc., with which the oxidation is necessarily very considerable, will increase the tensile strength by from 30 to 60 per cent., while with ordinary scrap brass, such as gates and sprues, etc., the tensile strength may be increased by as much as 35 per cent. This same amount (0.05 per cent.) of magnesium has been shown to give an increase of nearly 25 per cent. in the tensile strength of copper-tin bronze containing 10 per cent. tin. One advantage of magnesium is that, being a metal, by its use the presence of non-metallic substances in the mixture is avoided, which is not always the case when phosphorus and some other deoxidisers are used; though phosphorus, of course, is largely consumed during the process, and does not often remain in the metal to any great extent.

Magnesium has a specific gravity of 1.75 (water at 60 degrees Fahr. = 1), its melting point being about 430 degrees C. It will be seen that it is an extremely light metal, the specific gravity of copper being 8.93, while that of aluminium, the lightest of the common metals, is about 2.5. In addition to this quality of lightness, magnesium possesses a greater affinity for oxygen than any known metal, and these two properties render valuable service in the deoxidising of metals. In many respects it is like zinc—in fact, it belongs to the zinc group of metals—though considerably lighter than zinc, the specific gravity of the latter being 7.19; for instance, like zinc it burns in the air, forming an oxide. It must not be supposed, however, that because magnesium is used for producing brilliant light for photographic and similar purposes, that it will burn in the mass or stick, for only in a finely divided state will it burn; for flash-light purposes chlorate of potash is mixed with magnesium powder.

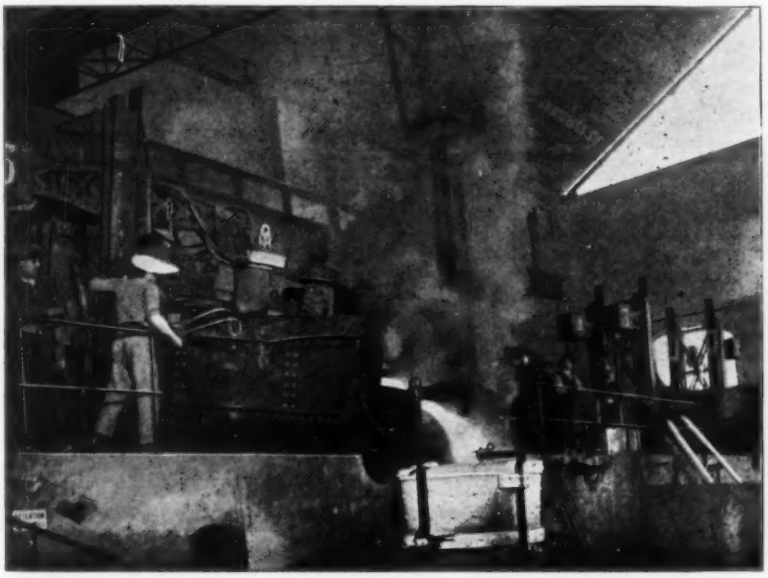


FIG. 9.—TAPPING THE 12½-TON FURNACE AT UGINE.

The action of magnesium on the copper alloys is not unlike that of zinc, though, to a greater extent, only a very small percentage being required to effect the deoxidation of the metal to which it is added. The property of decomposing carbon-monoxide when that is present in molten metals, is another important feature of the substance, and serves to produce metal free from gases. But while a small quantity of magnesium is so effective in producing sound alloy castings, the opposite results are obtained by the use of an excess, for if too much is used dirty metal and consequent bad castings result. This feature probably accounts for the fact that its use has not met with more general approval, for at one time amounts up to several per cent. were recommended as additions to the copper alloys. This, combined with the fact that formerly many of the magnesiums sold were very impure, gave the metal rather a bad reputation as a deoxidiser amongst brass founders. But now the metal can be obtained in a very pure form, thanks to the application of the electric furnace, and magnesium properly used can now be made a most valuable addition to the copper alloys in the foundry.

Casting Stereotype Plates.

(*Continued from page* 240.)

The illustrations of the hand-worked process of plate-making (published in our last issue) exhibit the principal operations referred to, and are representative of the most advanced state of the art when, in 1900, the Autoplate machine was first set to work in the office of the "New York Herald."

Speaking generally, the Autoplate consists of a casting mechanism and a series of finishing mechanisms which automatically co-operate in one machine to make the casts and finish them. When used to make plates of the conventional half-inch thickness, its speed is four finished plates a minute; but where the thickness is but a quarter of an inch, from seven to eight plates a minute are easily to be obtained. In the casting mechanism, which occupies one end of the machine, the matrix is placed. The operator by the movement of a lever starts the machine to casting, and this proceeds automatically until the desired number of plates is made and forwarded to the finishing mechanisms. Then, by a reversed motion of the lever, the casting mechanism is brought to rest, when the matrix is exchanged for that of another page. So quickly may this exchange be made

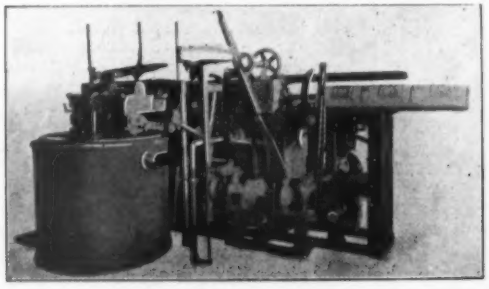


FIG. 9.—AUTOPLATE MACHINE; REAR VIEW.

that there is lost but the time required to make one cast. Meanwhile, the finishing mechanisms, which run continuously, finish and eject the remaining plates of the previous casting operation. While the machine is at work the matrix is cared for automatically: having been once inserted it requires no further attention until its full quota of plates is cast. The controlling mechanism is so constructed that the matrix is manipulated with the utmost gentleness and precision; and as many as a hundred casts may be made from a single matrix.

From the casting mechanism the plates go automatically through various finishing operations, and when delivered are ready for the press. These operations consist of sawing off the sprue, which is cast by the Autoplate machine at one of the straight edges of the plate; of sawing a narrow strip from the other straight edge of the plate; of shaving the plate's inner surface to bring the plate to accurate thickness; of accurately dressing the bevelled clamping edges and, upon the latest machines, of finally bathing its inner surface to cool the plate, without wetting its printing face. Thus, the entire work of casting, finishing, and cooling the plate is now automatically performed at the rate of eight plates a minute, by a machine which may be run by three men, whose only work consists of supplying its furnace with metal, its casting mechanism with matrices, and of removing the finished plates when ejected by the machine.

By the hand method of plate-making the same amount of work could not have been done by less than 35 men; and even with so large a force the saving of time made possible by the Autoplate could not have been obtained, for eight matrices instead of but one would have been required.

The following is a brief technical description of the machine itself. The core, about the lower half of which the plate is cast, is a cylinder having a journal at each end. These, being supported by the housing of the machine, hold the core in a horizontal position. The cylinder is fed with cooling-water, which enters through one journal to spray the upper side of its inner surface, and is syphoned out through the other. The cylindrical core has an intermittently turning movement; for seven-eighths of a complete

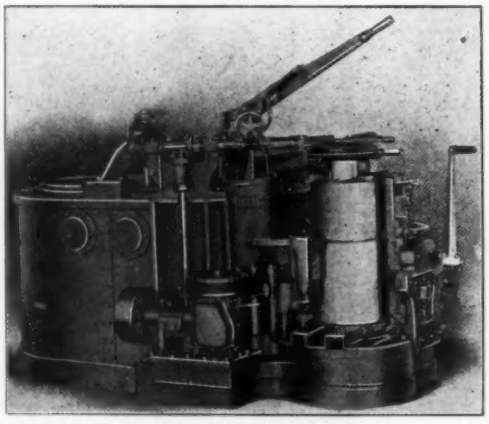


FIG. 10.—JUNIOR AUTOPLATE MACHINE: WHICH CASTS, CUTS THE RISER FROM, AND DELIVERS THREE PLATES A MINUTE; THESE HAVING TO BE SUBSEQUENTLY SHAVED AND COOLED.

action of the machine it is stationary, and during the other eighth is given a half turn and brought to rest. Thus, each of its two semi-cylindrical surfaces, or faces, is alternately beneath and above. Beneath the cylinder is a co-operating concave part, called the "back," which has a periodical up and down movement of about six inches. When in its uppermost position it embraces the lower half of the core, with space enough between the two in which to cast a plate of the desired thickness. For three-fourths of the machine's cycle of operations the back is in engagement with the core, after which it drops away, to permit the semi-rotation of the cylinder. The back, when casting is not being done, lies at rest in its lowermost position, ready to receive a matrix. At each of the straight sides of the back is a sliding bar carrying a spring-seated matrix-clamp. These bars are secured together and can be moved out or in after the fashion of a drawer. Extending from the back, towards the operator, is a concave continuation of the back, upon the straight edges of which these matrix bars run to their outermost posi-

tion. This extension is called the loading tray. In it the matrix is laid to be put into the clamps. After the clamps have closed upon it, the clamps and the matrix together are slid into the space intervening between cylinder and back. Then the casting-lever is thrown down, and the parts of the casting mechanism go into operation; when the back, carrying clamps and matrix, closes up beneath the under side of the cylinder, and the matrix is automatically positioned within the circle of the box. Thus, there is provided between core and matrix a semi-circular space equal in length, breadth, and thickness to the size of the plate to be cast. At one of the straight ends of this space, and completely closing it, is the long straight mouth of a pump-spout. Through this spout, rising from a pump which is immersed in a cauldron which usually holds 12,000 lbs. of molten stereotype metal, the charge of metal is sent immediately into the casting space described the instant the back has formed it. The opposite straight side of the casting chamber having already been closed by the matrix-clamping bar carried at that side by the back, the space is sealed and the charge of metal injected (about 40 lbs.) is securely held until it has been cooled by the water-chilled cylinder and back. As the pump plunger is operated by a cam-compressed spring, which continues to apply pressure to the

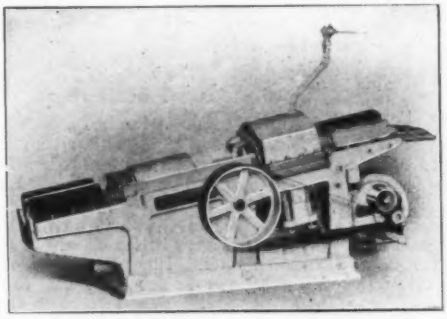


FIG. 11.—THE AUTOSHAVER: WHICH SHAVES, COOLS, AND DELIVERS PLATES MADE BY THE JUNIOR AUTOPLATE.

metal in the chamber during its solidification, the shrinkage of the cast is minimised. In the Autoplate machine metal is usually run at 475 degrees Fahr., and a half-inch plate requires about ten seconds in which to solidify. Therefore, after ten seconds of dwell the pump plunger is released, and draws down from the mouth-piece all the molten metal it contains, thus leaving nothing but the cast to be dealt with when the chamber is opened. So sharp is the line at which congealation ceases, an inch above the head of the plate, that after the remaining molten metal has run back into the pump cylinder, and the plate has been ejected, no metal, either in molten or solid form, is left in the mouthpiece to cause clogs, or other difficulties. The cast being hard, the back descends and the matrix-retaining clamps, which are spring-controlled, gently strip the flexible matrix from the plate. This still adheres to the under side of the cylindrical core about which it has been cast. So soon as the stripping of the matrix is finished—a delicate operation, performed with great dexterity and speed by the machine—the cylinder is caused to make its half-revolution, and the plate is brought thereby out of its position beneath the cylinder to that above it and comes to rest. Then the back, with its matrix, once more closes against the under side of the cylinder, the pump acts, and another plate is cast; this time upon the reverse side of the core. Meanwhile the first cast has been lifted from the top of the core and pushed along, upon its straight edges, between two horizontally rotating saws, making 3,500 r.p.m. These remove the narrow sprue cast upon one straight edge of the plate, and the narrower over-cast portion at its other straight edge, and trim the plate at both edges close up to its type surface. After passing the saws the plate goes beneath the dome of a shaving arch, where it comes to rest. Into the smooth inner curve of this it is then lifted and clamped, and a straight, rotating knife promptly smooths out its inner surface ribs, bringing it thereby to proper thickness. As the process of shaving gives the plate not only its thickness, but also the exact curvature of the press-cylinder upon which it is to be clamped, it is most important that it be accurately performed. This is insured by having the parts of great strength and accuracy, and by passing water through the arch-casting. The later prevents the distortion of the arch, and consequently of the plates, which would occur if the shaving-arch were permitted to accumulate heat, and expand. At each end of the shaving knife is fixed a small hook-like chisel. This reaches over the bevelled edge of the plate, made roughly in casting it, and trims the edge close to the type. By this time a second cast has reached the "shaver,"

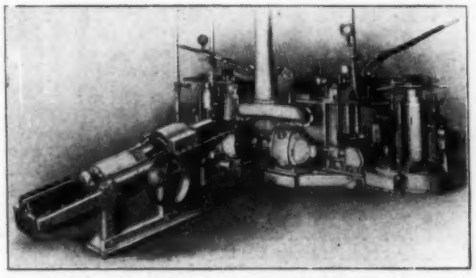


FIG. 12.—THE DOUBLE JUNIOR AUTOPLATE-AUTOSHAVER EQUIPMENT.

as that device is called, and the first plate, being finished, is drawn out by an arm and passed over a wetting apparatus. By means of the latter the plate is given a final cooling, from its inner side only, which leaves the type side dry. The plate, now finished and cold, is ready for press.

Coincident with the adoption of the Autoplate machine by the dailies of the larger cities there arose a demand, from newspapers of lesser magnitude, for a similar machine suitable to their needs. This was supplied in the Junior Autoplate, a very much less expensive apparatus, but one built upon Autoplate principles. Several functions, in the parent machine automatically performed, in the Junior Autoplate were assigned to attending workmen. In the Junior Autoplate the fundamental principles of the Autoplate machine recur: the matrix is stripped and repositioned without the intervention of the eyes or hands of the workman; casts are successively made upon alternate sides of a cylindrical core; a half-turn of the core simultaneously ejects a cast and presents a fresh casting-surface; and the closing of the chamber frees the preceding cast from the core so that it may thereafter be removed during the succeeding casting operation. In the Junior Autoplate, however, a new principle, among other minor ones, is to be found; the cast is cut from its sprue

while both are attached to the core, by means of a saw working in conjunction with the latter. The rate of production of the Junior Autoplate machine is three plates a minute. Its plates, however, as delivered by the machine, are not wholly finished but require thereafter to be shaved, dipped, and dried.

An apparatus called the Autoshaver was next provided to shave, cool, and deliver dry the plates made by Junior machines. This consisted of an inclined run-way of stud-supported, flanged wheels, along which the plate might run by gravity, upon its straight edges. At the upper end of this run-way was a receiving station, its exit barred by a cam-worked gate. Next along the route of the plate came a shaving arch, it also having at its lower end a cam-worked gate; then below the shaving arch a water-saddle, the exit of which was likewise barred and, finally, beyond this a receiving station beneath which rotated a brush, to clear the plate of such water as might adhere to its under side. Driven by the operating mechanism of the machine were cams which worked the gates, a constantly rotating shaving knife within the arch, clamps for therein securing the plate, and the brush. The shaving arch was cooled as in the Autoplate by the circulation of water, which went thence to the water-saddle. There, over a series of riffles, the water broke into cascades so arranged as to compel it to contact with the inner side of the plate, which it cooled. The Autoshaver made six revolutions a minute, and was capable of receiving a plate at each revolution. To use it it was only necessary that a plate from a Junior should be placed and left on the receiving stand, with its straight edges on the wheels of the run-way. At the proper moment the first gate opened and let the plate run into the arch, where the second gate arrested it. There it was clamped and shaved, and at the proper moment released to run out and onto the water-saddle. After having been there held for an instant, and cooled, it was released by the last gate, and ran forward to the delivery stand where, being brought to rest by a stationary stop, it was brushed out, and thereafter stood ready to be sent to press. Having a capacity of six plates a minute the Autoshaver was capable of finishing the product of a double Junior Autoplate machine.

Experiments with Electric Pig-Iron.*

Experiments have recently been made with the treatment of electric pig-iron in an open-hearth furnace and further refining of the steel produced. These experiments have been carried out at the Storfors Iron Works, and the results are appended. The quality and the composition of the electric pig-iron are shown in the following table:—

No. of Analysis.	C	Si	Mn	S	P
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
174	2.90	0.058	0.40	0.045	0.128
175	3.25	0.049	0.46	0.035	0.113
176	3.20	0.082	0.31	0.030	0.078
177	3.35	0.030	0.37	0.045	0.084

The pig-iron was extremely hard, and as shown in the analysis, the content of silicon was low. Two charges were melted, the composition of which was:—

Charge No.	Electric Pig-iron.	Scrap.	Total.	Fe Mn	Ore.
	kilos.	kilos.	kilos.	kilos.	kilos.
A 169	6,000	4,000	10,000	85	400
A 174	6,000	4,500	10,500	85	500

The furnace worked quite normally, and there were no evidences in the pig-iron of the poor quality which usually is associated with white pig-iron low in silicon. The decarburisation proceeded normally, and the tapping also. The metal proved to be good in every respect, externally as well as internally, as far as it could be judged from a longitudinal cut. The composition of the steel was:—

Charge No.	C	Si	Mn	S	P
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
A 169	0.10	0.003	0.65	0.040	0.032
A 174	0.12	0.003	0.57	0.035	0.034

The content of manganese is rather high, which is due to the rather large quantity of ferro-manganese in the charge, which was used in anticipation of a too low temperature for pig-iron with such a low content of silicon.

Treatment of the Steel while Hot.

On account of the Swedish strike only one ingot was dealt with, viz., No. A 174, and from this round rods, 2¼ in. in diameter, were rolled. These were further made into tube blanks with a diameter of 1¾ in., and a thickness of the walls of two-tenths of an inch. The steel proved excellent during these processes, possibly somewhat softer and tougher than ordinary Swedish steel. In order to ascertain the strength a sample was tested with the following results:—

Limit of elasticity	lbs. per sq. inch,	36,500
Ultimate strength	,, ,, ,,	51,400
Extension measured over 8 inches		34.4 per cent.
,, ,, ,, 4 inches		45.2 ,,
,, ,, ,, 2 inches		60.2 ,,

As far as could be judged from the cold-bending tests the steel proved to be softer and tougher than ordinary Swedish steel.

* "Jernkontorets Annaler."

BRASS CASTINGS TO MATCH TUBING.—Castings have sometimes to be made to match in colour brass or bronze tubing, and it is then a question as to how a brass free enough for turning is to be made without giving a change of colour, the tubing being of a composition too tough for the casting. The copper must not be materially decreased or the colour will be endangered, but the addition of a small amount of lead—say about 2 per cent.—will generally give the desired results. A slight increase in the tin contents would, in some cases, then be necessary to stiffen the brass, but this would not be enough to noticeably affect the colour of the metal. In the case of valve castings it is sometimes considered better to use no lead, and in such cases the zinc may be decreased considerably and the tin increased, the copper contents remaining the same. The colour might be very slightly changed, though not to any very noticeable extent, but more trouble would be experienced in machining than in the case of the alloys containing lead.

Business Methods for the Ironfounder.

Costings.

By Percival P. Richards, A.C.A.

(NOTE.—The Editor has arranged for questions arising out of this article to be dealt with by the author, who will be pleased to assist any readers who require further information on the subject treated. Queries should be addressed to the Editor of the FOUNDRY TRADE JOURNAL, as early as possible, if replies are desired in the next issue.)

The final objective of business is the making of profits, though, of course, reputation must not be sacrificed in so doing, such a course being a short cut which usually ends in disaster. The difficulty nowadays is to place on the market reliable work at such prices as will attract buyers and yet leave a fair margin of profit for the manufacturer. In order to do this it is necessary to be in touch with every working detail of the business, care being taken not to bury oneself in a mass of minor detail. This can only be done by working every branch of the foundry on an approved system specially designed to meet the peculiarities and local conditions applying to each case. It is, in short, necessary to systematise the business. This does not mean the purchasing of ready-made card systems of certain stereotyped forms. It means the gradual evolution of methods designed and based upon past experience and results, well tried, altered and amended, until the information obtained is in the best possible form for use in the particular business in question. The object of organisation, whether in foundries or factories, is to reduce production costs. The more highly organised the business, the lower will be the cost of production, and the more complete will be the details contained therein. This information, in its turn, leads to still more efficient organisation, and so the endless process continues; and it is the manufacturer who, appreciating the importance in his own case of these facts, and applying them to his own business, whose annual accounts will show the most satisfactory results.

Knowing the importance of this subject and believing it to be of interest to all readers of this journal who are connected with the business side of foundries, it is proposed to deal with a few of the main principles involved in its application to this trade. The reader must, however, bear in mind that only broad principles can be laid down; and although in some cases details will be given to illustrate the principles, if it is desired to apply the points to a particular case then the details must be worked out to meet all local conditions and special requirements.

The main object of organisation is profit making, and one of the principal factors regulating profits is production cost. The object of costings is twofold; first to record actual results obtained, and second to serve as a guide in present and future transactions. Information as to past performances, supplemented by later details as to the state of metal markets, labour rates, etc., is the best foundation on which to base further calculations and estimates. The actual arrangement of the costings figures is important, and the following form will serve to illustrate the explanations here given. The main items in the following costings form are:—(1) Material used. (2) Wages, (3) Pattern-making. (4) Machinery. (5) Stores used. (6) Trading or establishment charges.

Costings Form.

—	Total cost. £	s.	d.	Cost per ton. £	s.	d.
Materials used:—						
Metal—						
(Details and prices)						
Cupola charge—						
Coke or other fuel						
Limestone						
(Other items)						
Moulding materials—						
Loam						
Sand						
Plumbago						
(Other items)						
Wages:—						
(Full details, including such items as)—						
Breaking metal						
Loading						
Pouring						
Moulding						
Dressing						
Labourers						
Foremen						
Pattern-making:—						
Wages						
Timber...						
Metal patterns						
Machining						
Stores						
Total Materials and Wages						
Freight outwards						
Trading charges—per cent.						
Total cost						
Net profit—per cent.						
Selling price						

Materials Used.—Whenever possible the actual weights of the different kinds of metal used in producing a casting should be ascertained by weighing metal into the cupola. The quantities should be charged on to the costing sheet at the actual buying price. For smaller castings the cost of metal can be obtained by averaging the buying prices according to the proportions of the several kinds of metal melted for the day, in the cupola from which the metal is run. In order to facilitate quotations for repeat orders, the market prices of metal on the day should be noted on the cost card, but these prices should not be used, as the object of costing is to find the actual cost incurred in making the casting.

A sum must be added to cover the freight on metal bought according to the amount actually paid. For this purpose it may be necessary in some cases to strike an average. A further addition is necessary in order to cover waste in melting. This figure should be based on past results.

Statistics from the previous year will show the quantity of coke used per ton of metal melted, and this figure should be taken rather than an estimated one, and priced out at the current rate paid for coke. If other fuels are used the same basis of calculation would apply.

Coke for core stoves should not be included in the figure for cupola coke, but rather under the

heading of moulding materials, as it forms part of the cost of moulding.

Limestone and other cupola materials should be treated in the same manner as coke, that is, the cost per ton of metal melted should be based on the results of the previous year.

The item moulding materials includes loam, green sand, plumbago, blacking, etc., and the cost under this heading can best be obtained by taking the previous year's figures per ton of castings produced. If, however, several classes of work are regularly undertaken, then the total tonnage per annum produced under each class should be ascertained, and the total cost of each moulding material over the same period allocated to the different classes of work. For instance, in low quality castings no plumbago or lamp-black will be used. In others no green sand is necessary. In this way a reliable cost for moulding materials over different kinds of castings can be obtained. Of course, the figures when calculated will be used for, say, six months, or possibly a year, and then recalculated on the results of the past six months or year; although it may occasionally be necessary in the case of very special castings to amend the figure, but this does not often happen.

Wages.—Where wages are paid on the "piece-work" basis it is a simple matter to cost, as the actual rate paid will be entered on the cost card. For example:—Breaking metal, loading and pouring are often paid for at the rate of so much per ton of castings produced or per ton of metal melted, while the rate paid for dressing is fixed at so much per ton of casting dressed, according to the kind of casting. The cost of moulding, that is, the wages paid for preparation of the moulds and cores on the foundry floor, must be ascertained separately on each job. In order to do this every casting (or where more than one of a kind is made at the same time, every series of castings) should be given a number corresponding with the order number, and each moulder's time record should show the actual time occupied under each number. This information will then be summarised daily or weekly in the office, and each job charged with the amount paid to moulders, according to the time occupied and the rate of pay. Labourers' wages present more difficulty in allocation. When possible the items should be charged direct to job numbers as in the case of moulders, but where this cannot be done a rate per ton based on past figures and the class of casting involved must be charged.

Foremen's wages for supervision, which cannot usually be specifically allocated to jobs, can be covered by the addition of a percentage on moulders' and labourers' wages (taken separately).

Patternmaking.—If the job requires a special pattern the whole amount of the cost should be charged, but if the pattern serves for a series of jobs then a smaller charge should be made, bearing in mind that it is not desired to make a profit on the use of the pattern in addition to the profit on the whole job.

Machining.—In a foundry with an extensive machine shop it may be desirable to charge certain fixed machine rates, but ordinarily the actual cost of machining wages only should be charged under this heading. Machine rates should only be used where the machine shop is treated as a separate department bearing its own overhead charges, which are not included under the general trading or establishment charges.

Stores.—Items under this heading should, whenever possible, be charged direct to each job, but there will remain some balance on stores account which is not covered by these charges, and such total can be included under the heading of trading charges.

Any other items of prime cost not specially mentioned above should then be added, and the total down to this point will give the prime cost of wages and materials; each item of which should, for convenience in future reference, be stated, not only as the cost on the whole casting, but also as the cost per ton of the casting.

Freight.—If freight outwards is payable by the founder, then this charge should be added, as it will be included in the selling price.

Trading Charges.—The "trading" or "establishment," charges or "On cost" (according to the nomenclature adopted) should be added in the form of a percentage on the invoice price less freight (upon which no profit is made), the percentage figure used being based on the figures shown in the accounts for the previous financial period.

In the case of a costing prepared for the purposes of quoting, the selling price will be an unascertained quantity. To meet this, a calculation can be made in order to ascertain what percentage (for expenses) must be added to the total prime cost in order to cover the percentage fixed as above and based on selling price. When this expedient is adopted the main principle should not be lost sight of, namely, that the trading charges percentage should be based on selling price according to the results shown in the past, as this principle is most important in obtaining accurate costings.

Net Profits.—The percentage of net profit on selling price should be noted at the foot of the costing form in order that it may be on record for reference at any time. The most convenient way of recording costings is on cards which can be filed, or on specially-ruled sheets prepared so that they may be filed in a loose leaf binder, properly numbered and classified. Whichever method is adopted, a reliable system of indexing is necessary, as if proper use is made of the information thus recorded, the costing forms will be in daily requisition in regard to quotations, contracts, and repeat orders. To sum up briefly, let all figures used be accurate. Use facts, and do not estimate unless under very exceptional circumstances; never guess at any figures, especially trading charges. Do not base trading charges on a rate of so much per ton. To do so is to penalise low-class work, and to give undue advantage to high-class work. Above all make full use of the information obtained, for by so doing the best profits will result.

INSTITUTE OF METALS.—The Council of the Institute of Metals announce that they have accepted an invitation from the Glasgow members of the Institute to hold the Annual Autumn Meeting in Glasgow. This will take place on September 21 and 22, on which days Papers of scientific and practical interest will be read, and visits made to metallurgical works. An influential Local Committee, of which Professor Archibald Barr, D.Sc., is Chairman, and Dr. Cecil H. Desch, D.Sc., Ph.D., is Honorary Secretary, has already been formed to carry out the necessary arrangements, of which further notice will be given in due course. The Council of the Institute also announce that there has been established at the offices of the Institute a Pathological Museum for specimens of metals and alloys, the first contributions to the Museum having been received from the President, Sir Gerard A. Muntz, Bart.

Practical Hints on the Mixing of Irons for Special Castings.

By J. F. P. L.

From time to time the ironfounder is called upon to furnish the engineer with iron castings which have to possess special qualities. Important components are now constantly required, such as valves and cylinders for use with superheated steam; pistons to resist the flames of certain fuels which burn, but do not explode in the cylinder; kettles, retorts, etc., which must be able to withstand the attacks of powerful acid reagents, and so on. For these the ironfounder must find a material harder and more durable and of higher specific density than his ordinary grey cast-iron. It is not proposed to discuss here any system of improving the founder's mixture by additions either of steel or wrought iron. Such mixtures, melted in the ordinary cupola, are too often a failure. At any rate, it may be taken that any strength, density, or hardness obtained by this means can be got just as easily and with more certainty with pig-iron alone.

In making castings of the kind mentioned, the founder ought first of all to relegate the question of chemical analysis to its proper position, which is a secondary one. The primary factors are the physical conditions attending the actual melting and casting operations. Chemical analysis may tell us what a certain iron will do under certain fixed conditions, but what proximately determines the goodness or badness of a casting is the work of the melter and moulder; the state of the iron when tapped, its temperature when poured, the method of gating, rising, venting, and feeding, the speed with which the mould is filled, the temper of the moulding material, etc., these are the chief controlling factors. The foreman, melter, and moulder should pay close attention to these and choose those irons which will bring about the exact phenomena and conditions required during the actual processes of casting.

In a general way, of course, we are all guided by the original composition of the irons we use. Analysis may be considered of paramount importance so far as it has a predominating influence upon the melting points and specific weights of the different irons in the mixture. To this extent it must be studied, since these factors are influential during the manufacturing processes, whereas some parts of the chemical question relate only, or, at any rate, almost entirely, to the finished casting. So that it may at once be definitely established that the different irons constituting the mixture must be as nearly as possible the same in their carbon and silicon content; whilst as regards sulphur, phosphorus and manganese, these should be used freely in any way desired to create the physical conditions required during melting and casting and to regulate hardness.

What is wanted for superheated steam and for flame and acid-resisting castings is a combination of hardness, density, and stable and regular molecular structure. The best grey iron turned out by the average foundry of to-day will not be impenetrable and durable to the degree which such castings will have to be. For this work a mixture of irons will have to be chosen which represents the best possible compromise between the mechanical (strength) requirements in the finished casting, on the one hand, and the foundry requirements on the other. Regard must be had partly to both, and regard cannot be had solely to either. For if, with an eye solely to mechanical strength, it is decided to cast a cylinder of the purest and best obtainable iron, a metal would result (at the temperature at which the ordinary cupola could melt it, and at which the founder dare venture to cast it) having a very narrow range of fluidity, with which it would be almost as difficult to get a tight, sharp-moulded casting as it would with steel. Whilst, on the other hand, if the mixture were chosen solely with a view to its moulding properties (fluidity, fine surface, etc.) the result would be a soft and porous casting which would rapidly disintegrate under the attacks of superheated steam, of flame, or of any powerful acid reagent. It is necessary to get the strongest and densest casting possible, but it must be capable of being cast with a really lively and free-working metal. Any ironfounder will know how difficult these two are to combine; in fact, this is the real problem and fundamental difficulty of ironfounding for high-grade engineering work.

There are four kinds of direct iron-ore smeltings which the founder may use for the class of work under discussion:—(1) Purest English phosphoric coke-pig; (2) finest English strong coke hematite; (3) English cold-blast coke-pig; (4) best Swedish charcoal iron. To these a certain amount of selected machine scrap may be added. The first two named will run fluid, and for this reason must form the principal part of the mixture. The last two will be more viscous, and must, therefore, be used with caution. Of the first-named type, only an iron of proved suitability could safely be taken. It would have to be a very high-grade smelting, running very low in carbon, a most valuable feature for hard, dense, resistant castings. Of the No. 2 (hematite) type, an iron must be chosen running very low in silicon, but showing a perfectly grey fracture. Of the cold-blast and Swedish irons there are, of course, several brands of varying degrees of excellence.

A suitable mixture of these irons will give us a metal containing over 94 per cent. of pure iron, which will, nevertheless, melt very quickly and run very hot and fluid. The casting will be grey, and, if properly made, should have a specific density of at least 7.3. It will be perfectly machinable. If a slight mottle be allowed, which for this work is quite permissible, the density can be raised to 7.35 or 7.4.

In choosing these irons the first care has been to secure a tight, sharp-moulded casting, as close grain and regular molecular structure are more to be depended on to give the necessary strength than are purely chemical considerations. To get this tightness a highly fluid mixture must be used: for this fluidity the phosphoric pig may mostly be relied upon, and 30 per cent. of that may be taken as the basis of the specification. An iron of this type will certainly possess in some degree the quality of "shortness" or brittleness, but this shortness in phosphoric iron comes, as a rule, not so much from the phosphorus alone as from high phosphorus in combination with high percentages of other weakening impurities. A pig has been chosen which, though giving fluidity and heat from its phosphorus con-

tent, will positively help to lower the carbon in the mixture and to keep down the silicon. In taking this iron, therefore, chemical theory as regards phosphorus has been ignored and the working processes have been considered, and as regards the other elements, chemical theory has been considered without regard to the working processes. For, with a low carbon and low silicon combined with strong percentages of manganese and sulphur (which the mixture will have) much suction, liquid shrinkage and gas during casting must be expected.

After the fluid iron, strength must be more particularly attended to, but the great object is to get the strength without seriously damaging the fluidity of the mixture. This is arrived at by the addition of 25 per cent. of a special hematite iron containing a good percentage of manganese. There is now added 20 per cent. of strong iron, chosen from the point of view of strength alone. Either English cold-blast iron or Swedish charcoal iron could be used for this, but in the case of the latter the quality would have to be carefully specified. Many Swedish irons in which the sulphur and phosphorus have been reduced to the minimum show a very high carbon which cannot be permitted at any price in the mixture. Also the silicon in Swedish iron would have to be carefully watched; in their ordinary foundry pig the Swedish smelters seem to have some difficulty in producing grey irons when the silicon falls below 1.25 per cent. From some points of view the great purity of Swedish irons is disadvantageous for general foundry work. They are hard to melt, and run very sluggish from the average cupola, and though giving great toughness and strength, are often lacking in hardness. However, if the Swedish iron could be had with a carbon of 3.25 per cent. or less, and a silicon of 1.2 per cent. or less, it would do for this part of the mixture, though, in any case, it could never be so lively a metal as cold-blast iron. Brands of cold-blast are to be had with a carbon content of under 3 per cent. and a silicon of not more than 0.75 per cent., and showing a perfectly grey fracture. Such irons will be less viscous and will have a wider range of fluidity than the magnetic iron, owing no doubt to their slightly higher manganese and phosphorus content.

For the other 25 per cent. good, strong scrap-iron may be taken. The quality of machinery scrap may be fairly accurately judged from the colour and shape of the crystal, due regard being paid to the thickness of the section. Scrap showing sharp, pointed crystals packed fairly close will be a really good material; it will have a low melting-point, and should be placed in the cupola on the top of the pig.

In preparing this mixture the writer has considered certain physical questions, such as melting-points and specific weights of the various irons, but most of all the way in which the metal will behave when cast. There has also been considered the chemical side in its bearing upon the actual mechanical strength of the finished casting, as far as has been possible, and the carbon and silicon has been controlled in a very careful way. But the chemist's opinions in connection with the other elements has been to some extent disregarded. The highest possible tensile and transverse strength may not be found in the iron; but is this necessary? For cylinder work the writer claims that it is not. What is it that governs the engineer in his decision as to the thickness of his cylinders? It cannot be principally the tensile strength of the material; because, if so, cylinders would never be made as thick as they are. In calculating the thickness of cast iron to stand stress a "factor of safety" of 6 is generally taken, that is, for the purpose of the calculation the iron is reckoned to be six times weaker than it actually is, and, further, its actual strength it put at a much lower figure than would generally be found in cylinder iron, *i.e.*, the calculation would be based on an actual tensile strength of 8 tons instead of about 12. But even this would not account for the average thickness of cylinder walls, and it is probable that the engineer has chiefly an eye to porosity and the likelihood that his cylinder will have to be constantly rebored. In this specification, therefore, the engineer may get exactly what he wants; not increased strength, but greatly increased density and hardness, which means vastly improved wearing qualities. The writer is not so foolish, therefore, as to tie himself to nothing but the purest magnetite or hematite irons, and a low sulphur and phosphorus specification, which can only be arrived at at the expense of the working qualities and range of fluidity of the metal in the cupola, the ladle, and the mould.

As regards casting, the mixture should be melted as quick and hot as possible, and cast as soon as ever the right quantity of metal can be tapped—the hotter the better. A cylinder should be cast vertically, with the heaviest part uppermost, and the theory applied of getting a tight casting with liquid pressure. A sinking-head should be moulded on to the casting of a weight according to the weight of the casting and the judgment of the foreman, and the gates should be placed on this head. The head should exceed the casting in thickness where it joins it. This head has got to cool last, and by the immutable laws governing the cooling and liquid shrinkage of cast iron must feed all below it. The lighter part of the casting will cool first and draw iron from the upper and heavier part, and this part will in its turn as it cools draw iron from the sinking-head. The sinking-head should be supplied with hot iron and kept hot from a large, deep pouring-basin outside the flask. If the mould is filled quickly through gates of large area and the iron kept hot in the pouring basin, no pumping whatever will be required, and a casting tight and sound in every part must result. Even if cast in dry sand the mould should be well vented. Proper venting will help the gases away more freely and quickly and take a good deal of the strain off the mould itself.

IRON IN BRASS CASTINGS.—While iron in small quantities is sometimes purposely added to brass mixtures to increase the strength and hardness, it is generally regarded as a very undesirable impurity. If properly added in a small amount, iron exists in brass as a solid solution, but when present in large quantities too often separates out in the form of nodules and spots. Particularly in ingot metal run down from scrap and turnings is iron found, which feature prevents the use of such metal for good foundry work, especially if machining has to be done. Iron in the form of these nodules or spots is generally extremely hard, of the nature of chilled iron, and is thus very detrimental to the tools used in machining the castings. When present in quantities over 2 per cent., iron exists not as a solid solution but as a chemical compound, and in that condition renders brass very bad for machining, even though the hard spots mentioned are not found. The founder should, then, be careful not to let his metal become contaminated with iron. This may occur through the use of scrap metal containing iron, or that element may be taken up from iron or steel skimmers or stirrers if these are used, for they are rapidly acted upon by the molten metal.

The Equipment of the Grinding Department.

(*Continued from page* 254.)

Continuing the descriptions of grinding machinery published in our last two issues, we herewith present particulars and illustrations of some further machinery :—

A large double buffing and polishing machine, by Messrs. Rowland & Company, is shown in Fig. 17. This machine is of very strong, heavy, and massive construction, especially suitable for buffing and polishing heavy or large articles, such as are used in the manufacture of large locomotives, textile machinery, marine engines, stove grates, etc. It consists of a strong cast-iron stand, carrying a steel spindle of large diameter running in self-oiling ring-lubricating bearings. The spindle is fitted with fast and loose pulleys and carries the buffs one at each end outside the bearings. The size of polishing buffs is 30 in. by 6 in. or 36 in. by 6 in., according to the size of the machine.

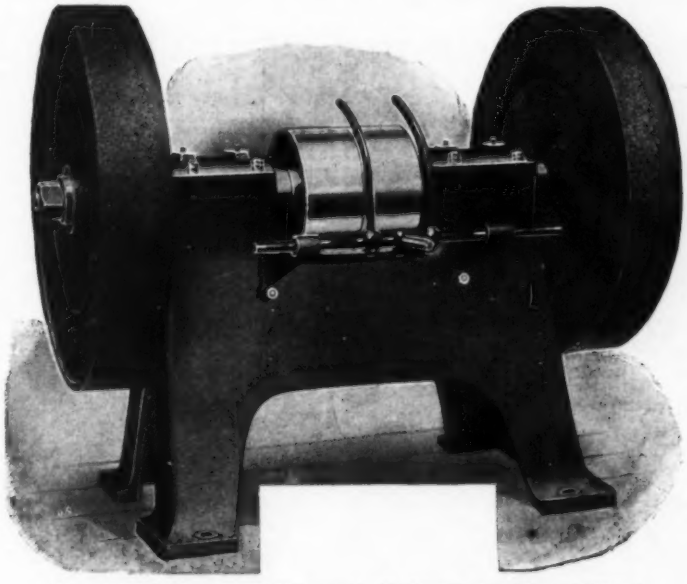


FIG. 17.—BUFFING AND POLISHING MACHINE FOR HEAVY WORK.

A buffing machine, by Messrs. L. Sterne & Company, Limited, is shown in Fig. 18. This machine is designed for carrying buffing wheels up to 36 in. diameter, and will be found very useful in locomotive and other shops for finishing motion-work and heavy bright work. The pedestals carrying the bearings are strong castings bolted on to a substantial sole-plate. The spindle is of steel, and runs in long bearings fitted with suitable lubricators. The machine is fitted with fast and loose pulleys and belt-shifting gear.

In Fig. 19 is shown a grinding attachment, being supplied by Messrs. Charles Churchill & Company, Limited, Leonard Street, Finsbury. Two sizes of this attachment are made, 16 in. and 18 in. It is clamped firmly to the frame of the grinder head, and may be turned back so as not to interfere with the use of the machine as an ordinary grinder, or is easily removed. An attachment of this kind will be found of advantage in foundries and machine shops where rough fitting is required, finishing iron patterns, etc.

A patent "segmental" face wheel, introduced by Messrs. Luke & Spencer, Limited, Broadheath, near Manchester, is shown in Fig. 20. It is claimed that with cup or face grinding wheels, made in a continuous circle or ring, carried in a shield or cemented on to a metal back-plate, etc., there is a great risk of the back-lip of a face wheel in a shield breaking away (through imperfect mounting), and where constant mechanical grinding takes place, the wheels often crack on account of the great heat generated, followed by rapid cooling, with its consequent contraction. With the wheel herewith shown, these disadvantages are claimed to be entirely obviated, while giving much quicker and cooler grinding. The chuck and its adjustments are of the simplest character. The grinding blocks or segments are securely and independently held in position in separate apertures, and, as they wear down, are easily and quickly brought forward, from time to time, as desired, until only about ½ in. of their length remains, thus ensuring the maximum economy in use. Should it be necessary to replace any of the blocks, this can readily be done without disturbing the remainder. The mechanism of the complete wheel consists of a circular chuck with enclosed apertures round its periphery to receive the segments, each being of a corresponding wedge shape; over each segment is a clamping plate running the whole width of the chuck, and which is held from falling, when a segment is removed, by

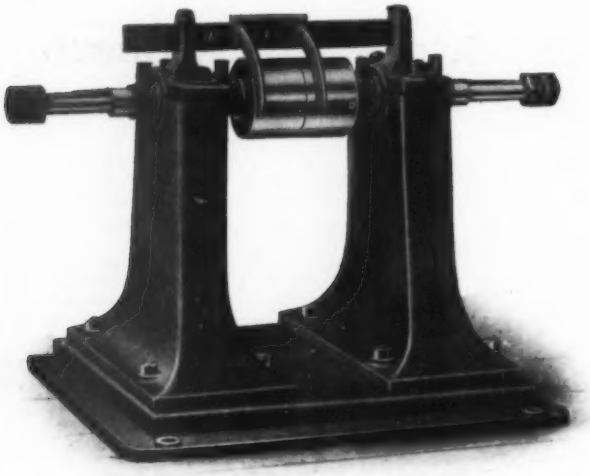


FIG. 18.—BUFFING MACHINE.

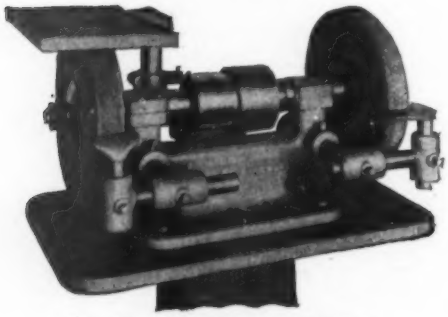


FIG. 19.—GRINDING ATTACHMENT.

FIG. 20.—SEGMENTAL FACE WHEEL.

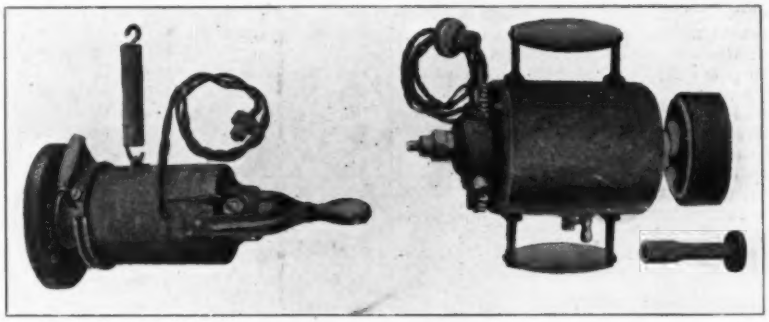
a small screw at the back of the chuck. Each segment is secured firmly by a set screw which is tapped through the enclosing metal ring; these screws acting on the clamping plates force the segments down into the aperture, thus securely wedging and clamping same. The heads of the screws are protected by two flanges round the periphery of the chuck, and also by the space between the flanges being covered with a thin steel band.

The "Hisey" portable electric grinders, which are suitable for a large variety of work, are illustrated in Figs. 21 and 22. These are intended for a large class of work which has hitherto been done almost exclusively by hand, and were particularly designed for cleaning and rough surface grinding of castings, etc. They can also be used with suitable wheels for buffing, polishing, and sanding. The smaller machines, Fig. 22, are convenient for use in the hand, and are furnished with a 4 in. extension mandrel carrying a small wheel for grinding in awkward places. The aerial surface grinders, Fig. 21, being too heavy for use in the hand, are arranged to be suspended from any suitable support, or slung with a counterweight from the ceiling, or a traveller. This type of grinder can be had in either of two styles, viz., with one fixed end handle and one adjustable body handle, as shown, or with two fixed end handles if preferred. In the latter case one handle encircles the wheel and projects beyond it. The body handle shown in the illustration can be moved around to any desired position, leaving the wheel entirely clear.

A machine, specially adapted for grinding and polishing work which cannot be carried and brought to a fixed emery wheel, is shown in Fig. 23. This machine is suspended from overhead, the work being placed on the floor, bench, or truck, and the emery wheel swung at will to conform to straight, or uneven surfaces. The wheel is driven from a swinging countershaft suspended by a telescopic rod, with a universal joint, which may be swung backwards at will; the frame carrying the wheel is also suspended by means of balanced weights jointed to a similar horizontal telescopic rod, which allows of the wheel being twisted to any angle, or of any range of movement being given to it up or down. The operator can hold handles fixed on each side of the wheel, and so guide it to any portion of the work desired to be ground. By substituting a circular wire scratch brush for the emery wheel, the machine will be found very valuable in a fettling shop, for cleaning large castings. It is also very useful for grinding off fins, spurs, and imperfections, instead of chipping wheel, the work can be finished with a much better finish than when performed by hand; and by substituting a polishing wheel, the work can be finished with a fine polish. The required tightness of the driving ropes can always be readily obtained by lengthening the telescopic rods. The belts are made of

sufficient length to allow the emery wheel to stand about 3 ft. above the floor level. The weight of the wheel, etc., is balanced by means of hanging weights. The makers of this apparatus are Messrs. Luke & Spencer, Limited, Broadheath, near Manchester. Similar machines are also made by

sists of a flexible shaft, stop clutch (which allows of the wheel being stopped and started, as desired, without stopping the motion of the shaft itself), clamp-spindle, and overhead countershaft, with suitable hangers, fast and loose pulleys, three-step cone-pulley, belt-shifting gear, etc.



FIGS. 21 & 22.—PORTABLE ELECTRIC GRINDERS.

Messrs. B. R. Rowland & Company, and by Messrs. L. Sterne & Company, Limited.

A useful style of portable grinding and polishing apparatus, by Messrs. Rowland & Company, is also shown in Fig. 24. These machines are particularly applicable for cleaning and grinding heavy castings, for buffing and polishing all metals and other classes of work which are too heavy or bulky to be carried

We have already remarked on the care and attention necessary in the running of grinding wheels, if breakages and accidents are to be avoided. The causes of abrasive wheel breakages are numerous and varied. Neglect on the part of the grinder to adjust his rest towards the wheel as the diameter of the latter becomes smaller through wear, followed by the articles being ground getting jammed

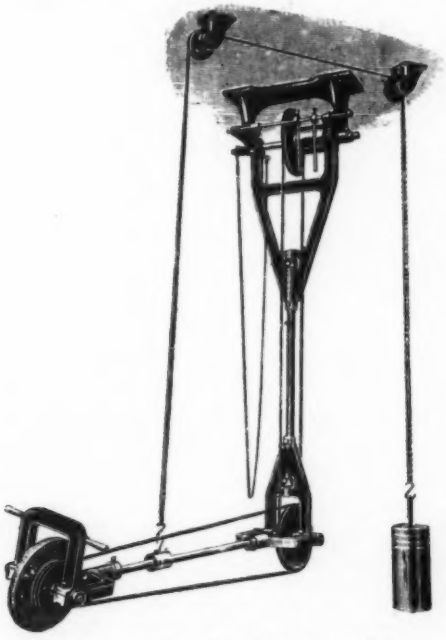


FIG. 23.—SWING FRAME GRINDER.

FIG. 24.—PORTABLE GRINDER.

and held to an ordinary grinding machine. The work operated upon may be placed either on the floor, bench, or truck, and the grinding wheel, which is driven by means of flexible shafting, adjusted to any desired position, to grind either straight or uneven surfaces. The apparatus con-

between the wheel and the rest, is a frequent cause. Neglect to true a wheel up, allowing it instead to receive a constant hammering, which speedily becomes worse and worse until the inevitable happens; too much play in the bearings, due to wear; forcing a wheel too tightly on to the spindle which heats up,

expands, and bursts the wheel; chipping a wheel to make it cut faster instead of trueing it up properly with a dresser or diamond; these are a few of the more common causes which are met with. There should be displayed in every places where a grinding machine is installed, a notice giving instructions regarding the proper mounting of wheels and their maintenance when in use. Where a number of grinding machines are at work a man should be told off to make a periodical examination of them, trueing up the wheels with a suitable tool as occasion demands, and rectifying any defects in the machines without delay. The small amount of time required for a frequent examination is well repaid by the better results obtained from the wheels, apart from the additional security attained. In this respect a grinding machine does not differ from any other type of machine, inasmuch as the best results are only achieved if it is well looked after and kept in proper condition.

Nevertheless, in spite of the most careful precautions, accidents will occasionally occur, and any device which will render the worker immune from harm in the event of a wheel bursting will, therefore, be welcomed by employer and grinder alike—the employer, because he is secure in the knowledge that if a wheel should burst from any cause a great amount of time, trouble, and expense will be saved, and the grinder, because he knows that all risks of injury to himself is eliminated. Such a device has been put upon the market by the London Emery Works Company, Park, Tottenham, London, N., in the form of their patent "Atlas" corrugated protection hood, as illustrated herewith. This hood possesses the useful feature of being easily fixed to almost any kind of grinding machine; moreover, it can be easily adjusted as the diameter of the wheel becomes reduced, so that the space between the wheel and the hood itself can be kept as small as possible, a most important point. A further advantage claimed is its flexibility, due to its being composed of several thicknesses of thin sheet steel instead of one solid piece.

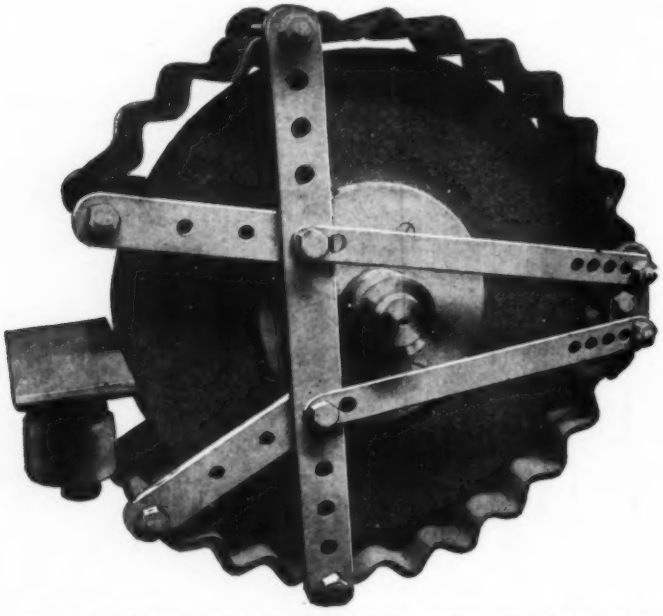


FIG. 25.—THE "ATLAS" CORRUGATED PROTECTION HOOD FOR GRINDING WHEELS.

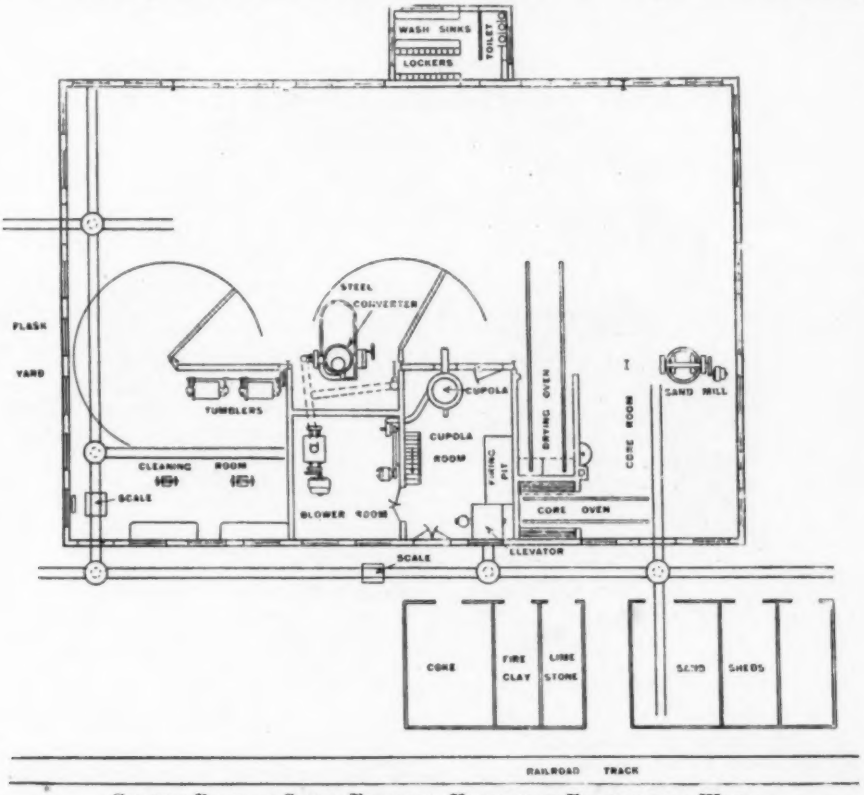
MANGANESE IN BRITANNIA METAL.—The familiar tin and antimony alloys known as Britannia metals often contain percentages of other metals, such as copper, zinc, bismuth, and lead, though copper is the only addition which has found considerable application, the amount in Britannia metals ranging from a very small quantity up to as much as 3 per cent. It is used to render the alloy harder and less ductile, since the tin-antimony mixture is very liable to distortion. But a very useful addition is also found in manganese, which forms a homogeneous alloy with tin, though its use is not generally known to the founder. It may be added either in the presence or absence of copper, the amount required being very little, from 0.015 per cent. to 0.20 per cent. serving to give a finer grain which will take a better finish than the ordinary mixture. Larger percentages may be introduced, but this is not always advisable, as the melting point of manganese is high, which means that it increases the sluggishness of the alloy at the temperature used to melt the Britannia metal. While the manganese may be added without copper, it is more convenient to add it in the form of cupro-manganese, as this allows the two metals with the highest melting points to be melted together first. After this is done the antimony may be added and finally the tin. The customary method of making first a hardening of copper and tin may be followed, the cupro-manganese being incorporated with the hardening, and this alloy melted first in the crucible before adding the remainder of the tin. The antimony may, also, if desired, be included in the hardening.

A Canadian Steel Foundry.

The demand for steel castings in the western part of Canada has kept pace with the rapid development of that side of the country, but until recently castings had to be shipped from the eastern part of Canada or imported from this country or the United States. On account of the opening that accordingly existed for a steel casting plant in that district, the directors of the Vancouver Engineering Works, Limited, early in 1909, decided to add a steel foundry to their plant at Vancouver, British Columbia. The side blower converter for making steel was adopted, and the first blow of steel was successfully made on October 12 last.

The plant has at present a capacity of eight tons per day. The building is of steel construction throughout, having a main bay 120 ft. long, and 50 ft wide, with a side bay 120 ft. long, and 30 ft. wide, as shown on the ground plan herewith. The cupola is of the standard Whiting type having a rated capacity of six to seven tons, and the height from floor level to top of stack is 35 ft. In order to properly charge the converter, the melting capacity is about seven tons per hour. The cupola charging floor is 22 ft. long and 20 ft. wide, and is served by a two-ton electric elevator, having a lift of 16 ft. In order to facilitate the handling of melting stock, an industrial track, 24-in. gauge, connects the elevator with the stock yard.

Iron is tapped from the cupola into a 6,000-lb. ladle, carried by a pneumatic jib crane of four tons capacity. The converter, having a capacity of two tons, is of the standard Whiting type. It occupies a floor space 20 by 12 ft., and is separated from the remainder of the side bay by a steel curtain wall. It is carried on cast-steel trunnions, which revolve in heavy cast-iron standards, and spans a concrete pit into which the ladle is lowered to receive the finished steel. A large hood is suspended above the converter, to carry the fumes outside the building. The height of the converter is 10 ft., when in blowing position. The air pressure ranges from 3 to 5 lbs. per square inch, and is regulated by a valve at the operator's platform. The blowing operation requires from 15 to 20 minutes. The reduction in the weight of metal is about 18 per cent., and the steel comes from the converter at 1,700 degrees C., a temperature insuring sufficient fluidity to yield sharp, sound castings of light section.



GROUND PLAN OF STEEL FOUNDRY, VANCOUVER ENGINEERING WORKS.

Back of the converter, and on a level with the foundry floor, is the blower room, which is equipped with a positive pressure blower for the converter, and a steel pressure blower for the cupola. The cleaning room adjoins the blower room, and opens into the main bay. The equipment consists of a cold saw and two power hack-saws. Two emery grinders provide ample facility for grinding the present output of the foundry. Provision has been made for the future installation of an annealing furnace.

Chromium as a Constituent of Brass.

Hitherto, although quite familiar as a constituent of special steels, chromium has not figured on the brass-makers' list of desirable additions. Now, however, this is no longer the case, for experiments have been carried out which would appear to indicate that chromium has a certain field of usefulness in connection with brass-making. At the latter end of last year there was patented in this country a method of introducing chromium, amongst other metals, into alloys of copper, such as brass, bronze, cupro-nickel, and tin.

Although chromium has long been known, it was not until the advent of the electric furnace that it was produced in a solid mass. Previous to that time it was obtained only in powder or fine crystals. Solid, massive chromium is now obtained commercially in two ways: By the so-called "aluminothermic" method, and by means of the electric furnace. The first process consists in reducing the oxide of chromium by means of aluminium. The reaction which takes place supplies heat enough to melt the chromium. By adjusting the proportion of oxide of chromium and aluminium it is possible to obtain fused, metallic chromium of high purity and free from carbon by this process.

In the electric furnace process, oxide of chromium is heated with carbon by means of the electric arc and the chromium is then reduced to the metallic condition. When thus made it is combined with a large percentage of carbon, and requires purification. To remove the carbon, the crude chromium is melted with lime in an electric furnace. The carbon combines with the calcium to form calcium carbide, and the pure chromium is obtained as a fused mass.

By either of the processes it is possible to obtain fused chromium of a purity of from 97 to 98 per cent. metallic chromium, which compares favourably in purity with ordinary commercial metals. Commercial 97 to 98 per cent. metallic chromium has a coarsely crystalline appearance, somewhat resembling in its structure that of antimony. It is brittle and is easily broken with a hammer. Its colour is white, approaching that of silver and without the yellow shade of tin.

According to Moissan, pure chromium has a specific gravity of 6.92, so that it is somewhat lighter than zinc. The melting point does not appear to have been determined; Moissan, however, states that it melts at a temperature considerably higher than does platinum, although readily fused in the electric furnace. As it is stated to be infusible in the oxy-hydrogen blowpipe flame, it will readily be seen that it cannot be melted by any ordinary means.

Pure chromium does not tarnish perceptibly in the air and is considered one of the most non-corrosive metals. It can be electro-deposited, and is not magnetic if free from iron.

Strong nitric acid and aqua-regia, either cold or warm, are without action upon it. Dilute nitric acid attacks it very slowly, and hydrochloric acid attacks it very slowly in the cold, though more readily when heated. Concentrated sulphuric acid, when heated, attacks it very slowly. Sulphur has no action upon it, except when heated red hot. The hardness of chromium is less than that of glass, as it does not scratch it unless it contains considerable carbon.

Reverting to the invention mentioned above, the object is to improve the qualities of the alloys mentioned by the introduction of additional constituents, or of further quantities of the existing constituents, in the form of phosphides. For example, it is found that the introduction of various small proportions of chromium may alter the properties of the resulting alloy, and in certain cases render the alloys considerably more useful for certain purposes. In introducing a metal into a copper alloy such as brass, a portion of the alloy metal is heated with a solid reducing agent, such as carbon, and a phosphate of the metal to be introduced, so as to produce a metallic solution of the phosphide of the metal to be introduced. Afterwards this solution of phosphide may be added in any desired proportion to the molten alloy. The phosphorus may be partly or entirely volatilised with a portion of the metal of the alloy, leaving the metal of the original phosphide in the alloy.

The following is a description of one method of carrying this process into effect for the purpose of producing a brass containing a small proportion of chromium. Chromium phosphate is intimately mixed with a reducing agent such as powdered charcoal, pitch or the like, and this mixture is heated with metallic copper or brass, the proportions and the temperature being such as to effect the reduction of the chromium phosphate to chromium phosphide, which is dissolved in the copper or brass. This metal solution of chromium phosphide is then added in the required proportion to the molten brass. In this second operation, some phosphide of zinc is formed and volatilised, leaving a brass (or copper-zinc alloy) containing metallic chromium, and, it may be, some traces or small quantities of phosphide. By such a method, it is claimed, it is possible to increase the ductility and tensile strength of the brass or otherwise to vary its properties.

The details of an actual test of the process are described as follows:—2,600 grammes of brass (copper 70 per cent., zinc 30 per cent.) were melted in a crucible together with 200 grammes of a mixture of equal parts of chromium phosphate and powdered charcoal and the whole mass kept at a temperature of about 1,000 degrees C. After the lapse of an hour another 200 grammes of the above mixture were added, and again after another hour another 200 grammes were added. Four hours after the first melting the metal was cast in an iron mould. During the above process the whole was thoroughly stirred every half hour with a piece of wood.

The metal produced by the above procedure contained chromium phosphide and was employed to improve the qualities of brass in the following manner:—1,516 grammes of copper were melted in a crucible and 655 grammes of zinc, and then 82.5 grammes of the chromium phosphide brass were added; the whole was thoroughly stirred, and then after twelve minutes was cast in a round iron mould. The metal thus produced when tested gave a tensile strength of 19 tons per square inch and an elongation of 72 per cent. on two inches. Brass made of the same sample of copper and zinc in the same proportions and under exactly similar conditions, but not treated with chromium phosphide metal, had a tensile strength of 14.4 tons per square inch and an elongation of 38.5 per cent. on two inches.

The patentees of the process outlined above are Messrs. W. H. Hodgkinson, F.R.S.E., Professor of Metallurgy at Ordnance College, and S. C. Peck.

Moulding Machines in the Jobbing Foundry.

By R. C.

It is doubtful if there is any other question in the foundry trade that has been discussed so much in recent years as the question of the moulding machine; and yet it is surprising what a large number of foundries there are that have not yet adopted its use. In fact, we may safely say that there are far more foundries without moulding machines than there are with them. Moreover it is astonishing what a number of founders have got them and are not making use of them; either because of lack of resource and initiation on the part of the foreman or the prejudice of the moulders in the shop, the machines often lay dismantled in one corner of the foundry. What, then, are the reasons why they have not been more extensively used?

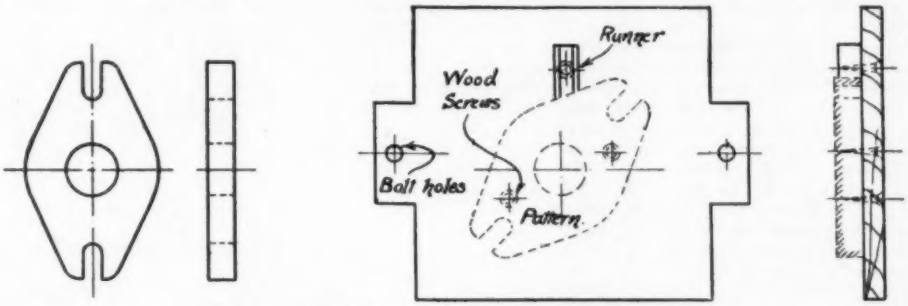


FIG. 1.—PATTERN WITH FLAT JOINT AND FLAT TOP.

Most readers will agree that the general answer to that question would be that the majority of founders are under the impression that machines are only profitable for repetition work and where large quantities are required. But the writer's experience goes to prove that machines may be successfully used in other than the repetition shop, and that great savings may be effected in the jobbing shop where patterns come in for perhaps only six or twelve castings to be taken off.

Let us consider what kind of machine is best adapted to meet the requirements of this kind of shop. The writer has no hesitation in saying a good turnover machine (either hand or power ramming), and having a good depth of draw, would be the best, although it might be mentioned that there is a machine on the market at present that can be used either as a turn-over, stripping-plate, or pulley and wheel moulding machine, which has a very wide range, and is sure to be extensively used in the jobbing foundry in the future.

In addition to the machine is required a good supply of duplicate moulding boxes in different sizes, say, 10 in. by 12 in., 14 in. by 20 in., and so on, also a few good plates either in wood or iron (or a few of both) to fit the boxes. The iron plates should have a large number of small holes drilled all over the face. It is also advisable to keep a good supply of runners (or gates) of different shapes, sizes and lengths. Now let us suppose a pattern sent in for 12 castings is perfectly flat on the top face, as in Fig. 1. With the tackle at disposal the patterns would be screwed on to the board, with a piece of runner of the correct size for running, and fastened on to the machine table in less than five minutes, and a good machine-moulder would easily make all 12 castings in less than half the time it would take the best bench or floor-moulder in the shop. This represents a considerable saving.

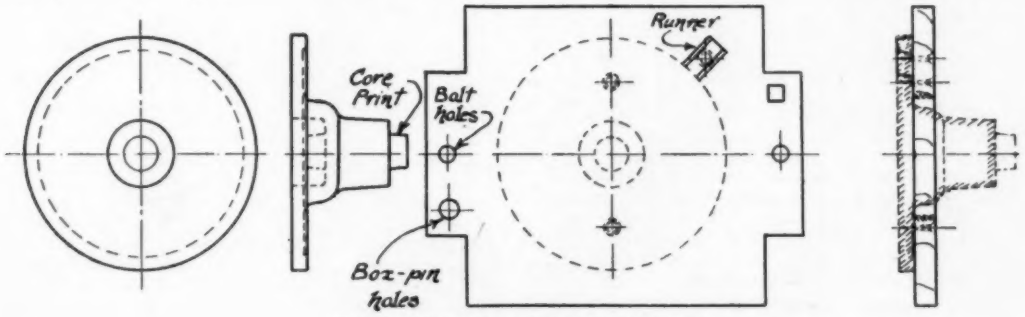


FIG. 2.—FLAT JOINT WITH SHAPED TOP.

It may be claimed that this could have been done without the aid of the machine, worked as an ordinary plate job. But it must be remembered that the pattern being worked from has not been got up specially for plate-work, and there would be much more likelihood of getting a good draw from the machine than if it was drawn by hand, and it is the time saved in finishing that counts.

Now let us go a step further and take a pattern that may have a flat joint, but not a perfectly flat

face, as shown in Fig. 2. Among the wood plates are one or two that have holes in to take bosses and projections of different shapes. The pattern is screwed on to one of these boards as in the previous case and all the bottom parts rammed up; an additional bottom part is now made, being rammed exceptionally hard, the pattern is screwed from the board and put in to this special bottom part, which now forms the master part for making the top parts from.

These are very simple and elementary methods, but when taken proper advantage of, effect a considerable saving for the founder; and when a start is made along these lines, it is surprising the amount of work that can be profitably placed on the machines even in the small jobbing foundry.

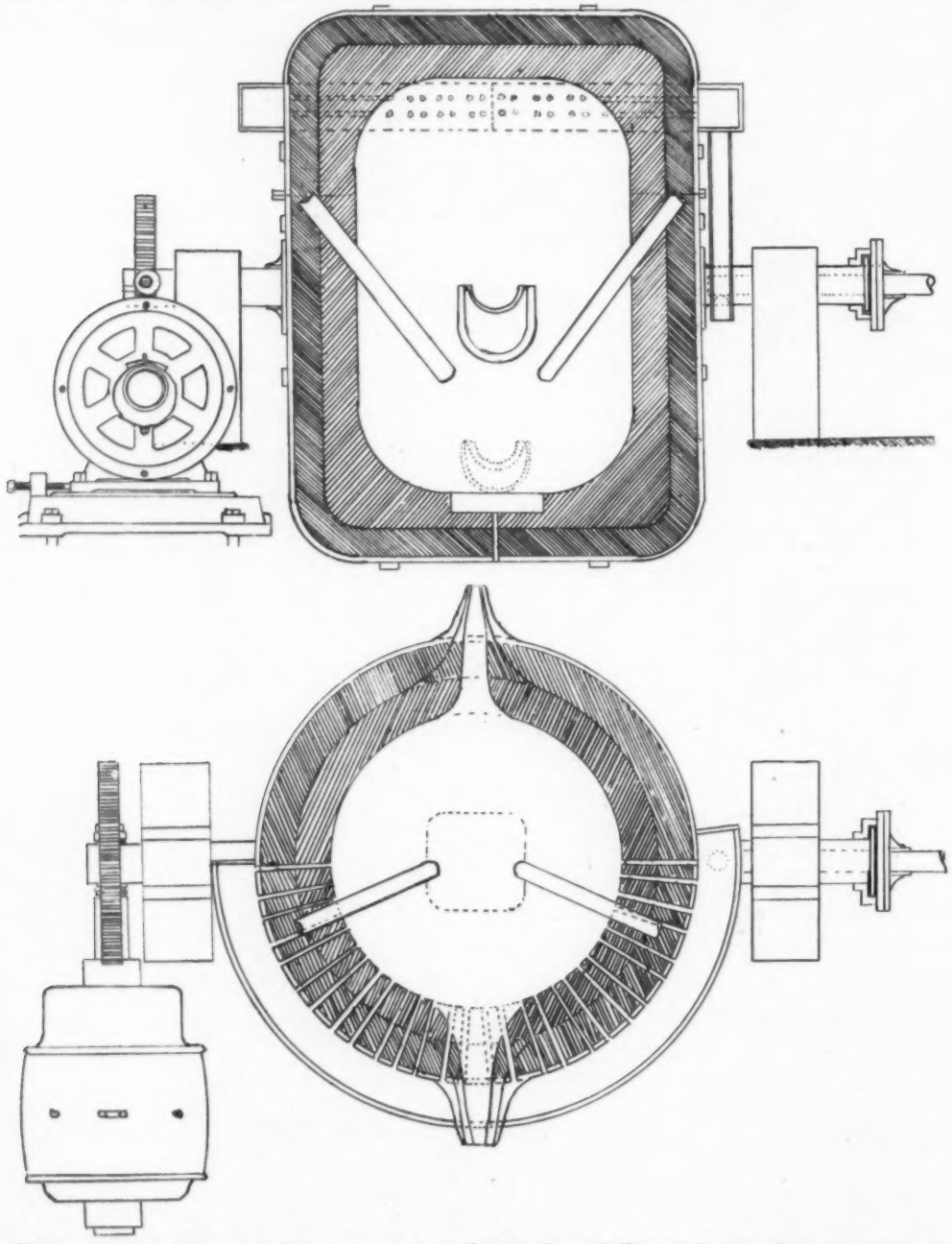


FIG. 1.—SECTIONAL PLAN AND ELEVATION OF THE "VERDON CUTTS & HOULT" ELECTRO-BESSEMER FURNACE.

A New Electro-Bessemer Process.

It is computed that energy equal to nearly 70,000 h.p. is now being utilised by electric furnaces in Europe and America alone, and the results have not only proved the practicability of the electric process for smelting and refining operations, but also that it has found a field for its operation for which it is unequalled.

The purification and conversion of pig-iron to high-grade steel is an operation to which the electric furnace is admirably suited. In the manufacture of high-grade alloys, such as those of iron with tungsten, titanium, chromium, etc., and also pure metals, results are now obtained which were either impossible or impracticable prior to the introduction of the electric furnace.

The high temperature at which the electric furnace works enables perfect adjustment of the sulphur and phosphorus contents to the extent of almost complete elimination of these elements where desired. Further,

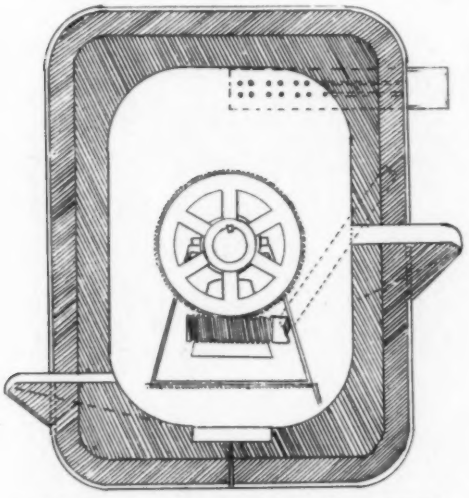


FIG. 2.—CROSS-SECTION OF "VERDON CUTTS & HOULT" ELECTRO-BESSEMER FURNACE.

owing to the exactitude with which carbon and alloys may be added, steels of any and every grade can be produced. Steel of crucible quality has been produced, and also that suitable for structural work. Drillings taken from different parts of ingots prove uniformity of quality.

Whilst these and other claims which are made for the electric furnace are now generally admitted, there are but very few furnaces yet working in this country. The reason for this is certainly not lack of interest in this modern development in metallurgy, but rather the working costs, which have been comparatively high. We have in this country an abundant supply of coal in the neighbourhood of our large works, and local and other conditions generally favour the blast furnace. Hence, there is no inducement to the ironmaster to adopt the electrical process for the production of pig-iron.

In the manufacture of steel this is not so. Electrical energy can now be generated at a reasonable cost (especially where blast-furnace or coke-oven gas is available), and the advantages of the electrical refining process are admittedly important. Still, the necessity of pouring molten metal from one furnace (be it the blast furnace, Siemens, or other) to another during refining, and the tendency towards an increase in complicated accompaniments, etc., have proved sufficient at least to delay the adoption of the electric furnace in this country for this work, to which it is so admirably suited. The process now adopted by a few firms (chiefly on the Continent) is briefly as follows:—An electric furnace is charged with molten metal direct from the blast or other furnace. After the addition and removal of slags, a carefully calculated mixture of iron and carbon is introduced. The necessary alloys are then added to obtain the grade of steel required.

Efforts have been made in various directions to reduce the current consumption; but not—until quite recently—to do away with the necessity of pouring from one vessel to another during the refining operation. Recently a process has been brought out whereby it is claimed that the highest grade steel can be produced without it being necessary to transfer molten metal to a second furnace after the commencement of refining. This process is the invention of Messrs. Verdon Cutts and Hoult, of 87, Fargate, Sheffield, and it is designed to combine the cheap and rapid operation of the ordinary Bessemer process, while the disadvantages of want of uniformity are entirely overcome by applying the electrical process of final refining.

The Verdon Cutts & Hoult electro-Bessemer furnace is a closed vessel, having an opening in one side through which the charge may be introduced, and slags added and withdrawn. It is mounted on bearings of ample size, and is capable of being tilted within an angle of 180 degrees, the motive power being either electric or hydraulic with suitable gearing interposed. One end of the furnace is fitted with blast tuyeres for bottom blowing. At the other end of the vessel electrodes are arranged, entering through the furnace wall, and being adjustable by any of the ordinary independent methods—either electrical or mechanical. A tapping hole is provided at this end of the furnace for the finished product. Samplings may be taken from the charging opening, which opening might also be used—if desired—for pouring the molten metal. The electrodes are fitted with cooling jackets of cold air or water.

The process is simple in the extreme, being briefly as follows:—

The furnace is pre-heated in the ordinary way, and is then charged with molten metal direct from a cupola or blast-furnace mixer, the furnace being tilted into a horizontal position. It is then brought to a vertical position, the "Bessemer" portion containing the charge. The blast comes into action automatically as this position is gained, and the process of conversion proceeds as in the ordinary Bessemer converter. Meantime, the "electric" portion of the furnace is heated by the hot gases, etc., resulting from this process, and for the ultimate removal of which gases ample provision is made. On the completion of this part of the process, the furnace is tilted, and the metal transferred to that end which is provided with electrodes. Current is switched on and the refining operation carried on to any desired extent. Both arc and resistance heating are obtained in the furnace.

The accompanying rough drawings are sufficiently detailed to show the principle of the new electro-Bessemer furnace.

Foundry Plant and Equipment.

Adjustable Flask-Stripping Moulding Machines.

A new style of moulding machine is now being placed on the market by the Osborn Manufacturing Company, Cleveland, Ohio, U.S.A., an important feature of which is that it is adjustable to different sizes of flasks. Each size machine is arranged to take four regular widths of flasks, either solid or snap, and 15 different lengths. The machine was invented by Charles F. Knowlton and Frank B. Elliot, of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., where it was thoroughly tested before being placed on the market.

In the old styles of flask-stripping machines it was necessary to have expensive stripping plates, and one for each pattern. Moreover, only a limited

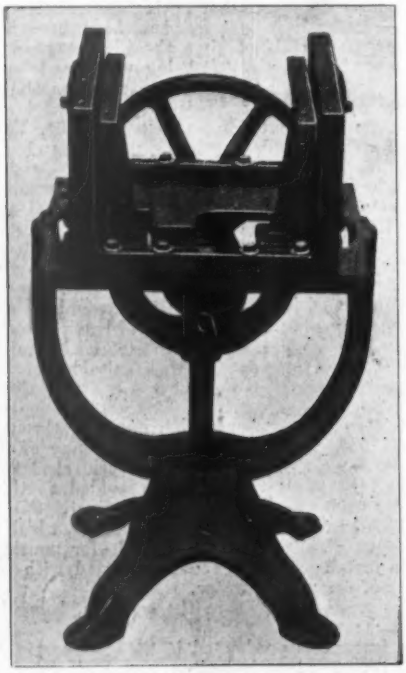


FIG. 1.—STANDARD TYPE FLASK-STRIPPING OSBORN MOULDING MACHINE.

number of sizes of flasks could be used on these machines. In the Osborn machine the patterns are mounted on plain cast-iron plates carrying the flask pins which strip directly from the flasks, thus drawing both the pattern and the pin in the same operation and avoiding the necessity of expensive stripping plates.

The standard type of the machine is shown in Fig. 1. It handles such work as is ordinarily done on the bench, and uses either wood or iron snap or solid flasks. Attached to the top of the frame are adjustable strips which are screwed in place and can each be moved about ¼ in. to take up slight variations in the flasks. The flask rests on the top of these strips and the open ends allow any length of flask for each width. The main adjustment of the machine to fit different widths of flasks is made by moving the sides of the machine in or out, which can be done quickly after the screws in the frame and two screws beneath the pattern carrier are loosened. The two parts of the pattern carrier are attached to the sides, so as to move laterally with them, but to slide vertically independently of them, and the correctness of their adjustment is secured by dowel pins that fit in holes accurately spaced. The pattern is fastened on the plate, the length and width of which can be varied according to the size of the flask used. This plate contains either flask pins or holes, as the case may be. After the pattern is properly mounted, the flask is placed on the machine, with its sides resting on the stationary side supports and its ends on the pattern plate; the flask is located by the pins or holes in the plate.

FIG. 2.—SPECIAL 10½-IN. DRAFT OSBORN FLASK-STRIPPING MOULDING MACHINE.

It is then filled with sand and rammed by hand, after which the pattern, plate and pins are drawn down by a turn of the wheel. The draw is secured by a series of folding links, which give a considerable draw in a small space. The guides of the pattern carrier are each made in one piece and are adjustable in all directions to compensate for wear. It is claimed that the machine has a straight, smooth draw, which is assured by the adjustable guides to the pattern carrier, and the quarter bearing of the multiple links upon the upper base of the frame. The machine is built of cast iron and steel, and the parts of machines of similar sizes are interchangeable. The best results can be obtained by having two men to each machine, one on the cope and the other on the drag.

The standard type of the Osborn machine is made in three regular sizes, handling flasks from 9 in. by 10 in. up to 20 in. by 34 in. Each side has a maximum pattern draw of 6 in. A total of 96 standard flasks can be handled on these three machines. The same principle of construction and operation is applied to the other types of the machine. Fig. 2 shows a 10½-in. draft machine intended for heavier work than the standard machine. It is adjustable to flasks from 11 in. by 11 in. to 20 in. by 30 in. Fig. 3 gives two views of a special machine, designed for making moulds that require a long pattern draw, and is intended for still heavier work usually done on the floor. It has a maximum pattern draw of 36 in., and is especially adapted for transformer cases and similar work. It is designed to be placed in a pit, with the drawing table and flask supports set at any desired height above the floor level. This machine will accommodate flasks from 16 in. by 20 in. to 28 in. by 36 in., and can be used for castings weighing up to about 800 lbs. The left view in Fig. 3 shows the

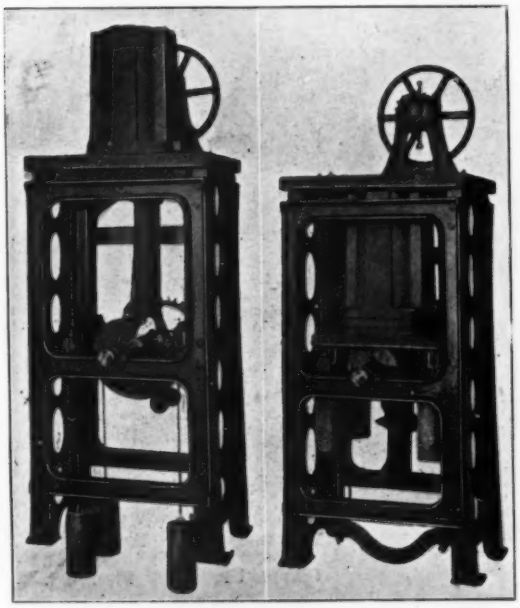


FIG. 3.—THE OSBORN 36-IN. DRAW MACHINE WITH PATTERN IN POSITION FOR RAMMING THE COPE, AND WITHDRAWN.

machine with the pattern in position for ramming, and the right one shows it with the cope of the pattern drawn. As may be seen in both views, counterweights are used to balance the pattern.

An Oil-Fired Crucible Furnace.

An improved type of oil-fired crucible furnace for brass, white-metal, babbitt-metal and zinc is shown in the accompanying illustrations. This style of furnace can be got ready for melting in about two minutes, whereas with a coal- or coke-fired pit furnace up to half an hour is required to regain the melting heat each time the fire has to be rebuilt. Among the advantages claimed for the furnace shown is that it is possible to melt brass and copper to form an alloy without burning out the brass borings, as is usually the case with an ordinary type of furnace. It is claimed, too, that it will melt any kind of metal, from copper to scrap sheet zinc, at an operating cost of 6½ cents (3¼d.) per 100 lbs.

Fig. 1 shows the furnace closed, with the crucible and upper brick dropped, while Fig. 2 depicts the

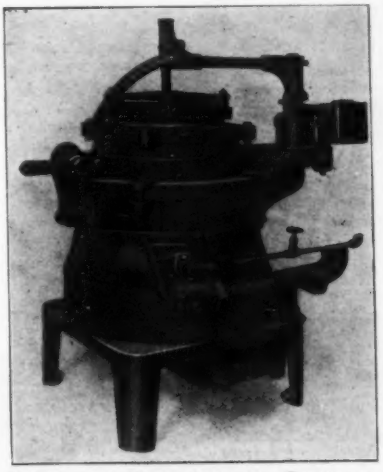


FIG. 1.—OIL-FIRED CRUCIBLE FURNACE; CLOSED.

furnace open. The top is equipped with a round brick which encircles the crucible and is close to it. This method of construction forces the flame upward, and enables the operator to use charcoal,

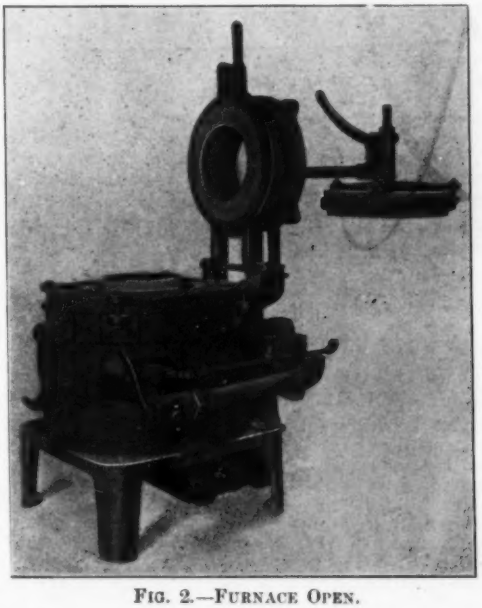


FIG. 2.—FURNACE OPEN.

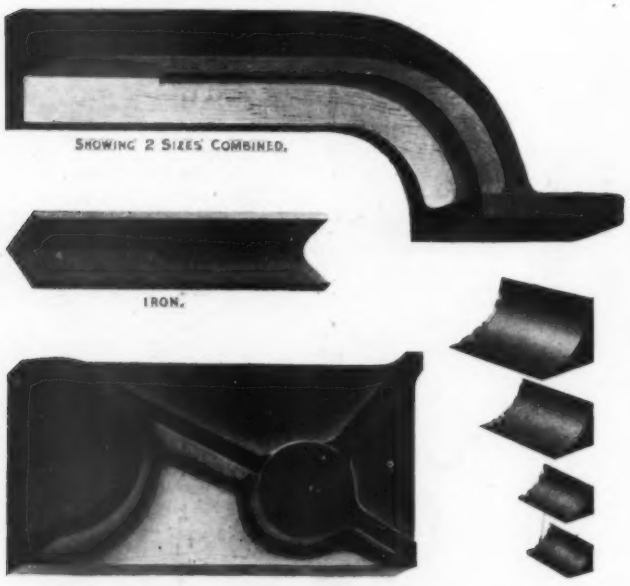
thereby preventing any possibility of the oxidisation of the bronze or other metal charged in the crucible.

These furnaces, which are manufactured by Alfred Fisher, Chicago, U.S.A., are built in four sizes, the

two smaller sizes being equipped with one burner, which is the type illustrated, and the two larger ones with two burners. The top of the furnace is provided with a cover, which is placed upon a ring and equipped with two vents so as to draw the heat upward. This furnace, it is stated, is capable of taking a heat in one hour without any possibility of burning the most delicate alloys in the metal. The blast is delivered through a 2½-in. pipe operated by a positive blower. The oil consumed varies from two and a half to three gallons per hour, and is fed through a 1¼-in. pipe through a small needle valve which regulates the proper pressure of the oil. The crucible is removed the same as from a coal furnace.

A New Type of Fillet.

The illustration shows a number of fillets made with "Redistik," a new material which has recently been put upon the market by James Evans & Company, Britannia Works, Blackfriars, Manchester. The difficulty of producing with metal or leather—the most commonly used filleting materials—a perfect, neat and uniform fillet, so essential to a good casting, is generally recognised. This applies to even the smallest fillets; with those of large size it is almost impossible to make a thoroughly solid job with leather. The makers claim that with the use of "Redistik" these difficulties cease to exist. The material consists of certain waxes combined with fabric, supplied with the edges accurately cut, and the advantages claimed for it are cheapness, simplicity, flexibility, and its rapidity of application. It requires neither glue or cement, being simply placed in position and rubbed down with the fillet tool, when it adheres firmly and is equally adaptable to wood or iron patterns.



ILLUSTRATING THE APPLICATION OF "REDISTICK" FILLETS.

Electric Lights for Foundries.

A very handy form of stretching and pendant electric light for use in engineering workshops, moulding shops, etc., is illustrated in the annexed

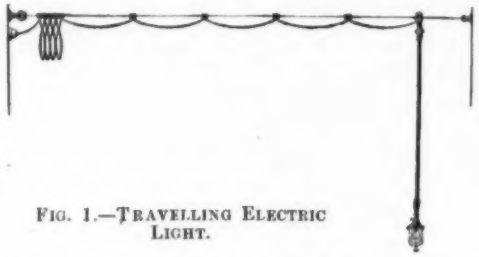


FIG. 1.—TRAVELLING ELECTRIC LIGHT.

cuts. The great advantage is that there is no stray cord lying on the floor and no counterweight pulleys to inconvenience the user of the light. Owing to the arrangement for travelling, the same light may be used at any desired point within a range of 40 ft., the cord travelling along a steel wire, as shown in Fig. 1. When closed this length of cord occupies only about 12 in. of space in length and drops 16 in. The stretching pendant is attached to the lamp end of the travelling cord, and allows the light to be brought down to about twice the normal drop of the light. If the height of the fixture will not allow the necessary length of pendant to give the required extension, the adjustable hook shown in Fig. 3 can be employed. It will readily be seen that such an adaptable light could be very usefully employed in drawing offices, pattern stores, and numerous other places where it is desired to avoid installing a large number of lamps.

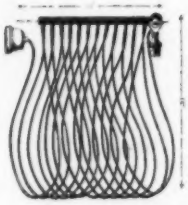


FIG. 2.—TRAVELLING CORD CLOSED UP.

FIG. 3.—ADJUSTABLE HOOK FOR PENDANT.

The makers and patentees of this system are Messrs. Thomas Laurie & Company, electrical engineers, Falkirk.

A High-Pressure Sand Blast Apparatus.

The high-pressure sand blast apparatus shown herewith has a special type of nozzle and separate lines of hose for the sand and the compressed air. This machine will operate at and steadily maintain any reasonable pressure, but the best results are obtained by employing a pressure og about 100 lbs. per square inch.

Fig. 1 is a sectional view of the apparatus, which is known as the "Kelly," and Fig. 2 illustrates the

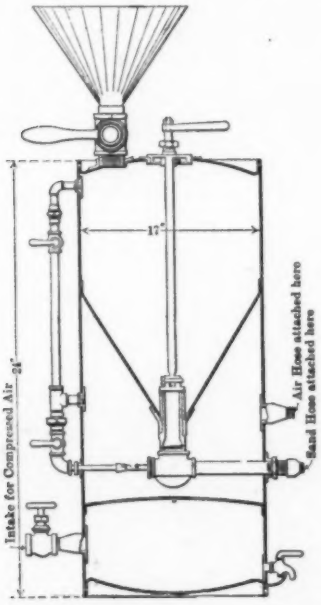


FIG. 1.—SECTIONAL VIEW OF THE "KELLY" SAND-BLAST APPARATUS.

nozzle. The apparatus is made of No. 10-gauge galvanised iron with riveted and soldered seams, tested to withstand an air pressure of 300 lbs. Clean, sharp sand which has been screened through a No. 10

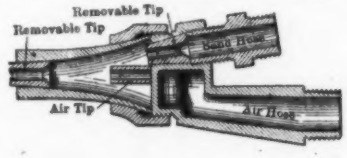


FIG. 2.—NOZZLE OF "KELLY" APPARATUS.

mesh sieve is poured through the funnel in the top of the machine. The sand tank is provided with sloping sides to direct the sand into the pipe to which the sand hose is attached. Air is admitted under a pressure of about 100 lbs. from the compressor near the bottom of the machine, and passes off through the air hose outlet higher up on the opposite side of the tank.

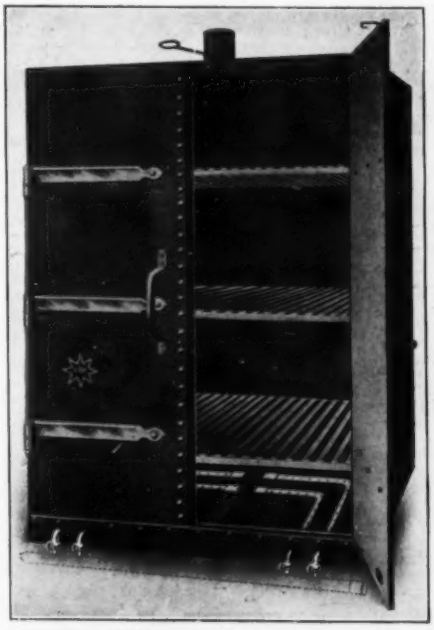
The compressed air is carried through a 1-in. hose from the machine to the nozzle where it attains a high velocity by passing through an orifice 3-16 in. in diameter. This hose is not subject to any wear, and will stand an air pressure of 150 lbs. A ¾-in. hose is employed to convey the sand from the sand tank to the nozzle. This hose takes a mixture of sand and air at a low velocity, and feeds it into the high velocity jet, and the combined jets of sand and air then pass out through the ¼-in. orifice at the end of the nozzle at a comparatively high velocity. Removable tips are used where the nozzle is most exposed to wear—that is, at the orifice at the end of the sand hose and the opening at the end of the nozzle where the combined jet of sand and air passes out.

While the blast can be operated by compressed air under any pressure from 15 to 150 lbs., according to the class of work to be done, the best pressure for cleaning iron and steel work is from 90 to 100 lbs. At the latter pressure about 70 cubic feet of free air is used per minute.

This apparatus is made by the High Pressure Sand Blast Company, New York, U.S.A.

A Core-Drying Stove.

It is scarcely necessary to insist on the convenience of utilising gas for heating the core-drying ovens in a foundry. Where there is no waste heat from furnaces, etc., available to maintain the tem-



A USEFUL CORE OVEN.

perature of the core oven at the desired point the best service can be obtained from gas-firing, which has the advantages of being easy to regulate. In the illustration herewith we show a useful form of core-drying oven manufactured by the Alldays & Onions Pneumatic Engineering Company, Limited, Birmingham. The supply pipes for the gas, it will be seen, distribute the heat well over the floor of the stove, and are each regulated by a separate cock.

Inventions.

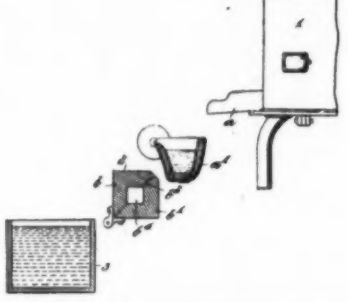
Applications for Patents.

An asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicators are in brackets.

9,345.*Moulding and casting brake shoes. (James Hill, United States.)
9,406. Manufacture and treatment of steel. H. A. Richardson.
9,447. Moulding boxes or flasks. C. Lever, 139, Dale Street, Liverpool.
9,518. Pressure casting apparatus. W. H. Bowling, 323, High Holborn, London.
9,622. Mechanical moulding box for the use of hand or machine moulding. T. B. Holt.
9,665. Copper alloy. A. Ballingall and J. Ballingall, 96, Buchanan Street, Glasgow.
9,677. Prevention of the escape of fumes from crucibles in brass-founding operations. W. Ross and T. Ross, 121, West George Street, Glasgow.
9,750. Raising, turning and lowering heavy objects such as mould boxes. P. B. Jagger, 3, Broad Street Buildings, Liverpool Street, London.
9,821. Ingot moulds for use in compressing machinery. S. J. Robinson and G. Rodger, 24, Norfolk Row, Sheffield.
9,940. Gas-fired furnaces. Fletcher, Russell & Company, Limited, and T. W. Fletcher, 4, St. Ann's Square, Manchester.
10,139.*Oil furnaces. J. K. Walker, 154, St. Vincent Street, Glasgow.
10,409. Melting furnaces. W. G. Moore and C. B. Hooper, 6, Corporation Street, Birmingham.
10,410. Heating and annealing furnaces and muffles. W. G. Moore and C. B. Hooper, 6, Corporation Street, Birmingham.
10,442. Machine and process for preparing heavy scrap metal for utilisation. H. W. Gabbett-Fairfax and G. B. Company, Limited, 33, Cannon Street, London.
10,785.*Producing drying air in drying furnaces for the moulds in foundries. P. Mongen.
10,917.*Electric furnaces. A. Frantzen.
11,117.*Melting furnaces and gas burners therefor. E. R. Brayshaw.
11,169. Furnaces. J. K. Thompson.
11,454.*Lowering device for moulding engines with turn-over plates. C. Köchling, 345, St. John Street, London.
11,455.*Machine for treating moulding-sand. C. Köchling, 345, St. John Street, London.
11,456.*Moulding engines with turn-over plates for the manufacture of basins, etc., with high rear wall. C. Köchling, 345, St. John Street, London.
11,716. Electric furnaces. J. Thomson.
11,717.*Electric furnaces. J. Thomson and F. A. J. FitzGerald.
11,718.*Electric furnaces. F. A. J. FitzGerald.
11,720.*Furnaces. J. Thomson and F. A. J. FitzGerald.
11,765. Sand-moulding machines. S. Netherwood, Brass Foundry, Bacup.

Abstracts of British Patent Specifications recently accepted.

15,183 (1909). *Producing from Foundry-iron a Metal Product having Cutting Properties of High Grade Tool and High Speed Steel.* E. A. Custer, Baltimore Avenue, Philadelphia, Pennsylvania, U.S.A.—This invention relates to the art of producing a product capable of being tempered and used for tools, such as are usually made from high grade tool steel. It has been proposed to employ chilled cast iron as a material for making tools for wood and metal working, the iron being melted in any suitable furnace and then poured into chills made to the required form and size of the tools desired to be produced. To render the tools thus made very hard, it has further been proposed to take them from the chills whilst at a high temperature and cool them in water, oil, or other liquid or fluid substance. Such tools, it has been stated, could be tempered to different degrees of hardness, according to the purposes for which they were to be used. The process constituting the present invention is on similar lines, but the essential feature lies in the fact that the metal is removed from the mould or chill as soon as it is set, and is then quenched in the fluid bath. The improved process for producing a metal for tools, therefore, consists in chilling ordinary foundry iron to the setting point in a permanent mould, and then removing the metal and quenching it in a fluid bath, as water. This process produces a tool which, as practice has demonstrated, compares favourably in cutting and other qualities with tools constructed of the present high grade tool steel of commerce. A certain percentage of nickel, tungsten, vanadium, titanium, or other metallic substances or alloys may be added to the iron in the molten state. The accompanying drawing illustrates diagrammatically a type of plant adapted for producing the product of this invention. The indicating Figure 1 represents an ordinary cupola-furnace provided with a pouring spout a, and ladle a^1, located in proximity to a permanent sectional metal mould 2, consisting of a cope b, and drag b^1, having pour-holes b^2,

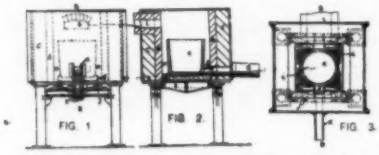


Arrangement for Producing Cutting Tools from Cast Iron.

located about the meeting edges of two sections of the mould 2, and having internal channel-ways, not shown, directly leading to a central cavity b^4, of any required shape or form. The molten metal from the cupola-furnace 1, passes by the pouring-spout a, into the ladle a^1, and thence into the mould 2, and therein it is swiftly chilled to the point of setting, covering as to time but a few moments, when the mould is opened by the parting of the cope b, from the drag b^1, if a horizontal mould, as shown, or if a vertical mould, one part or section is separated from the other part or section, to enable the cast structure set in the mould to be removed immediately after being cast so as to be quenched in a cold water bath 3, to chill suddenly the hot structure to a cool state. Practice has demonstated that this effect upon ordinary foundry iron, when so treated, is to fix the changed molecular conditions, that is, to give a fine texture thereto, and to establish throughout a homogeneity to the structure cast, which is accomplished by the swift chilling of the molten foundry iron first in the permanent metal mould to establish the defined homogeneity to the structure; and then second by the quick cooling of the cast solid structure, by quenching it in a cold water bath, to fix reliably throughout the homogeneity of such structure. Ordinary grey foundry iron containing from 2 to 3 per cent. of silicon, .09 or less per cent. of sulphur, .03 to .06 per cent. of manganese, and 2 per cent. or less of phosphorus, gives good results in practice. The colour of the metal affords an indication of the time to remove

it from the mould for quenching, and of the degree of hardness obtained after quenching. For instance, if the casting is removed from the mould at a bright yellow heat, it will be harder than if it is removed at a red heat and quenched. This hardening action depends upon the amount of combined carbon that is in the iron at the time of quenching, and it naturally follows that if the iron is quenched at a yellow heat, it will contain more combined carbon than if it is quenched at a brght red heat.

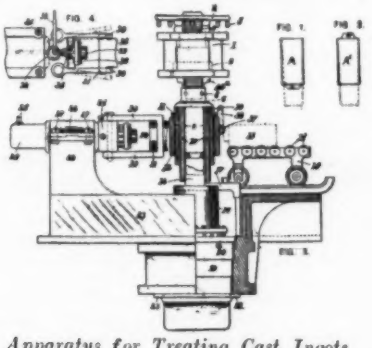
8,903 (1909). *Crucible Furnaces and the Crucibles used in same.* J. Newton, Station Street, Longport, Stoke-on-Trent, and C. Billington, Station Street, Longport, Stoke-on-Trent.—Figure 1 is a front elevation showing the lip or trough *a*, which forms the conduit through which the molten metal is caused to flow from the crucible into the ladle; Figure 2 is a section of Figures 1 and 3, at B, B; Figure 3 is a plan showing the crucible *e* in its working position. *c* is brickwork, and may be either common brick or firebrick. *d*, is a



Crucible Furnaces and the Crucibles Used in Same.

firebrick lining which can be removed at any time, without damaging or disturbing any other part of the furnace. *e*, is the crucible, and *f*, is the spout on same which connects the crucible with the conduit. *g*, is a fireclay block which is fixed on steel support *h* and is used to carry the crucible in its position. *i*, *i*, are firebars which are fixed upon pivots *j* and held in position by levers *k*. *l*, is the flue which connects the furnace with the stack or chimney. *m* is the coke space.

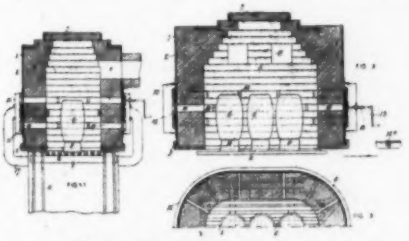
7,226 (1909). *Process and Apparatus for Treating Cast Ingots to Remove Cavities therein.* I. Preks, 34, Riga Perspective, St. Peterburg, Russia.—In Figures 1 and 2 the dotted lines show the cast ingot, and the full lines the ingot already compressed with the necks which contain the contraction cavities and the waste. The neck *a* or a^1 is on the narrowest side of the ingot A and on the widest side of the ingot A^1. This is due



Apparatus for Treating Cast Ingots to Remove Cavities Therein.

to the fact that the casting of the ingot A was done from the narrow side and that of the ingot A^1 from the wide side. It will be seen that the transverse dimensions of the compressed ingots A A^1 are larger than the dimensions of the cast ingot and that the length of the compressed ingot is only two-thirds of the length of the original ingot. The apparatus for carrying out the process comprises the combination of a heavy press for the compression, and a smaller one working at an angle thereto for rapidly handling a large quantity of ingots, as well as a matrix that can be inclined at will. The construction of the machine for carrying out the process on a large scale is shown in Figures 3 and 4, of which Figure 3 is a side elevation of the press, partly in section. Figure 4 is a plan of the upper portion of the horizontal hydraulic cylinder of the press. The upper cross beam of the press 1 contains the press screw 2, which works in the nut 3 shown by a dotted line. A fly wheel 4 is provided for tightening or loosening the screw by hand by means of the handles 5. The moveable head 6 of the press screw is secured to the screw by the pins 8. The matrix 9 is provided with rings 10 strengthening the matrix and a supporting ring 11. A cast iron sleeve 12 rotating about a horizontal axis, encloses the matrix which is in vertical position when the ingot is being pressed, and in horizontal position when the ingot already compressed is being ejected on to the carriage 14 travelling on rails. In order to place the ingot into the matrix, it is first of all necessary to turn by means of the lever the casing of the column 42 until the lug 52 is disengaged from the projection of the casing, whereupon, oy acting on the handle 38, the matrix is brought into the horizontal position. The ingot is then placed on the rollers of the carriage 14 and pushed, small end first into the matrix. The matrix is then placed in the vertical position the casing of the column is returned into its place and by means of the screw 2, the ingot is forced into the interior of the matrix as far as possible. It is only necessary then to start the hydraulic press, commencing the compression process of the ingot. For withdrawing the ingot already compressed from the matrix, the latter is placed in the horizontal position, the clamps 30 are placed on the edges, and the ingot is forced on to the rollers of the carriage 14 by means of the horizontal press. During the compression of hot steel ingots in the manner described, the matrix 9 of the press becomes heated so that for cooling the matrix after the compressed ingot has been removed, the matrix 9 can be sprayed inside with water.

20,293 (1909). *Crucible Furnaces.* J. W. Chenhall, Dart Villas, Totnes, Devonshire.—Figure 1 is a sectional elevation; Figure 2 is a side sectional elevation; Figure 3 is a sectional plan. 1 is the furnace casing, 2 is the furnace lining, 3 the base plate, 4 the furnace bars, 5 the furnace barbearers, 6 the flue, and 7 the top plate. The crucible 8 is adapted to be mounted on a stand 9 on the furnace bars 4. The ash pit 11 may be enclosed as shown when blast is employed or open for natural draught. The furnace lining 2 has a plurality of holes, openings, or apertures 12, communicating with the outside of the furnace. The draught holes are preferably equi-distantly spaced around the furnace, and extend in range from about a point adapted to come opposite the middle of the crucible to its top or a little above the top. These draught holes are adapted to be covered by dampers 13, preferably

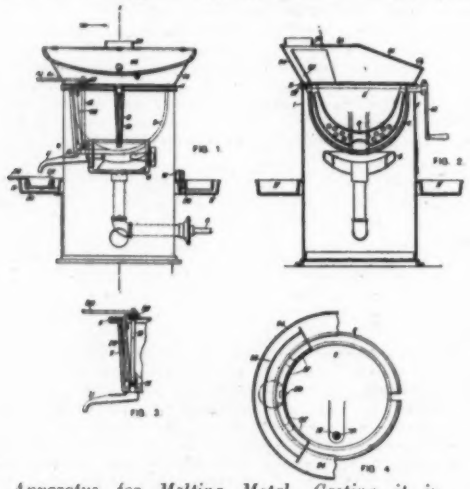


Chenhall's Crucible Furnace.

made as a slide within a guide 14, the damper being formed in a continuous length around the furnace and controlled with a pull handle 15, rack and pinion 16^a, or mechanical equivalent. As the draught holes are laterally disposed there is practically no opportunity of their becoming clogged or closed by clinker, which in practically every type of coke-fired crucible furnace is a source of trouble by clogging the fire bars and

choking the draught. Moreover, the greatest zone of heat is immediately around that part of the crucible in which the process of fusion is taking place, for once the contents of the crucible start to melt the molten metal falls and is kept in a state of fusion by the heat produced by the fallen incandescent fuel that is beneath the draught holes. Since in practically all fusions of metal it is advisable to reach the melting point with the greatest speed, the question of degree of heat or temperature level is an all-important factor to success. It is found that with a furnace of this type not only is the time for melting very considerably reduced, but the consumption of coke is less, and the number of heats a crucible will stand is considerably increased.

10,135 (1909). *Apparatus for Melting Metal, Casting it in Ingots and Cooling the Latter.*—R. T. Johnston, Park Avenue, Scotch Plains, New Jersey, U.S.A.—Fig. 1 is an elevation of the apparatus, with parts shown in section; Fig. 2 is a vertical section on the line 5—5 of Fig. 1, looking in the direction of the arrow and omitting the frame 20 and the moulds 22 shown in that figure; Fig. 3 is a sectional elevation of the valve, and Fig. 4 is a plan of the pot 2, with part of the hopper and flue removed therefrom. 1 is the cylindrical frame of the furnace; 2, the pot in which the metal is melted; 3, a flange by which the pot is supported on the frame 1; 5, a burner under the pot 2 to melt the metal therein; 6, its supply pipe; 9, a crescent shaped stirrer practically parallel with the sides and bottom of the pot 2, and mounted to rock by its ends in bearings in opposite sides of the said pot;



Apparatus for Melting Metal, Casting it in Ingots, and Cooling the latter.

10, a crank handle fast on one of the ends of the stirrer for working it; 11, the discharge spout from the metal pot 2; 12, a valve controlling it; and 13, the valve stem. 17 is an ingot-cooling water trough fast to and surrounding the frame 1; 20, a frame supported within the trough 17 by rollers 21 mounted on its inner edge to run on the top of the trough 17; 22, ingot moulds supported in the frame 20, and dipping into the cooling water in the trough 17; and 23, a handle to each mould 22 by which it can in turn be brought under the spout 11, to be filled, and the frame 20 and the whole series of moulds can be moved round the trough 17, and by which also can each mould 22, with its now cooled ingot in it, be removed from the frame 20. The conical hood of the principal patent is replaced by a hopper 24, which has a cover 25 having a door or lid 26 giving access to the interior of the hopper 24. The latter, conjointly with the melting pot 2, is capacious enough to hold as much unmelted metal, cast type bars or the like, as will, when melted, fill the melting pot. 27, 27, Figs. 2 and 4, are ports for the products of combustion; they deliver into a flue 28, which extends to within a short distance of the cover 25. 29 is the flue from the hopper 24, to carry off from it both the products of combustion and the fumes from the molten metal in the pot 2. Figs. 2 and 4 show that the flues 28 and 29 are not continuous, that the flue 29 is opposite the middle portion of the flue 28, that the latter extends past it in both directions, and that the cover 25 will act as a baffle to the products of combustion, compelling them to fill the hopper 24, and to thereby keep atmospheric air from the surface of the molten metal in the pot 2, whereby the oxidation of that metal is prevented. The valve 12 is opened and closed by a lever handle 30 working in a slot 31 (Fig. 1) in the hopper 24, and fast to the upper end of the valve stem 13 (Fig. 3), the valve stem having the usual screw 32 working in a nut in the fixed guide 33, in which the valve stem is capable of being turned. No means are provided for filling the trough 17 with cooling water or changing such water; if desired, this may be effected by hand, access to the trough for the purpose being obtained by lifting one of the moulds 22 out of the frame 20.

The "F.T.J." Bookshelf.

The Principles and Practice of Iron-Founding.

By E. L. Rhead, F.I.C., F.C.S., etc. Manchester: The Scientific Publishing Company.

This recent addition to the foundryman's library consist of a series of articles contributed to the Press during a period extending from 1905 to 1908, based on a course of lectures given by the author at the Municipal School of Technology, Manchester. To those who know Mr. Rhead as the lecturer in metallurgy at that school it will be unnecessary to say that this book represents quite modern foundry practice and science. While a volume of this nature is necessarily a practical work, there is much of an essentially scientific character which has an important bearing on founding, and which requires to be explained. With this in mind the author has kept his readers well in touch with the principles on which the best practice is based, while at the same time avoiding laborious explanations and details, such as too often encumber valuable papers that emanate from the laboratory. There is much in the work, of course, which has become familiar to students of foundry literature, but there is also much that does not appear in other handbooks, Moulding in green sand, dry sand and loam, is thoroughly explained in principle, while the subject of cores and core-making is dealt with much more fully than is the case in many foundry text-books. The cupola and its accessories, however, do not receive such full consideration as their importance warrants; a lot of valuable information is included, and the general principles of cupola working are well set forth, but more might, with advantage, have been written on this subject, for it is with the cupola that so many foundrymen find themselves in difficulties. As against this, the chapter on malleable castings will prove very acceptable, for it condenses into some thirty pages in an excellent manner the essentials of foundry practice for malleable castings. Taking the book throughout, attention has been mainly directed to the causes underlying many of the troubles encountered in practical work, to the conditions that must be fulfilled in order to avoid them, and to the precautions necessary to secure the best results. In this respect it is somewhat apart from general foundry and moulders' text-books, and what it lacks in respect to foundry plant and equipment is compensated for in other directions.

Trade Talk.

THE CARRON COMPANY intimate that they are opening extensive premises at 114, George Street, Edinburgh.

MR. G. E. FOWLES, fender manufacturer, late of Birmingham, now of Sparkhill, has been adjudged bankrupt.

THE TEUTONIC STEEL WORKS, LIMITED, have transferred their business from Rockingham Street, to Watery Street, Sheffield.

MESSRS. S. H. CARTER and F. WHITE, iron brokers, etc., Bradford, trading under the style of Carter & Company, have dissolved partnership.

MR. D. C. GLEN, M.I.Mech.E., has established himself in business at 46, Queen Victoria Street, London, E.C., as a consulting and inspecting engineer.

MESSRS. C. ATKINSON AND T. P. LEATHER, engineers, Ardwick, Manchester, trading under the style of Atkinson & Leather, have dissolved partnership.

JOHN SHAW & SONS (WOLVERHAMPTON) (LIMITED), of Wolverhampton, have removed their London offices from 38, Snow Hill, E.C., to 118 to 122, Holborn, London, E.C.

ON May 10 the 20-in. main steam pipe of the cogging mill at Newburn Steel Works, Newcastle-on-Tyne, burst, and carried away a portion of the roof of the building.

MESSRS. C. A. HARNDEN & COMPANY, engineers and machinists, have transferred their business from Cooper Street to Boston Mills, off Mottram Road, Hyde, near Manchester.

MESSRS. J. PINSON, A. BARNES, and C. SANDERS, brassfounders, Birmingham, trading under the style of A. & J. Pinson, have dissolved partnership so far as regards Mr. A. Barnes.

MR. ROBERT MCALLISTER, iron and brass founder, Johnstone, has taken over the business of the Dimity Foundry Company, Johnstone, previously carried on by Mr. John Smith, Springfield, Johnstone.

THE SKINNINGROVE IRON COMPANY, LIMITED, Carlin How, have placed an order for a Héroult electric furnace. This furnace will be used for the refining of open-hearth steel for rail or structural purposes.

MESSRS. ROGER & COMPANY have established works on the Manchester Road, Hyde, where they are putting down a plant for the manufacture of steam traps, valves for super-heated steam, and general brass founding.

MESSRS. J. S. MOORE, A. KING, and G. S. WILFORD, malleable iron founders, etc., Sheffield, trading under the style of the Pelham Foundry Company, have dissolved partnership, so far as regards Mr. J. S. Moore.

THE firm of Bisset & Company, engineers and blacksmiths, 68½, West North Street, Aberdeen, of which Mr. George Bisset, Mr. Alfred Bisset, and Mr. Alexander Bisset were the sole partners, has been dissolved as at March 30.

OWING to Mr. Rowcliffe, the principal, retiring from business, the Atlas Engineering Works, Levenshulme, Manchester, will be finally closed down at an early date. The whole of the plant and running machinery has already been disposed of.

MESSRS. DAVID SPALDING & MUIR, 11, West Regent Street, Glasgow, the trustees of the trust estate of John Robinson & Company, mill and engineers' furnishers, Glasgow, intimate that they are now in a position to pay a first and final dividend.

MR. W. H. SIMPSON, A.M.I.C.E., Corridor Chambers, Leicester, who has received an appointment under the Government, has disposed of the engineering part of his business to Mr. E. J. Silcock, M.I.C.E., 11, Tothill Street, Westminster, London, S.W.

THERE was a large attendance of members at a general meeting of the Institute of Metals at Storey's Gate, St. James' Park, London, S.W., recently, when Professor W. Gowland read a paper on "The Art of Working Metals in Japan."

AT the reduced upset price of £7,000 the site and buildings of the Dundee Foundry in East Dock Street, Dundee, formerly belonging to Gourlay Brothers & Company, Limited, were purchased on May 23, on behalf of the Works Committee of the Dundee Town Council.

DAVID BROWN & SONS, (HFD.), LIMITED, of the Park Gear Works, Lockwood, Huddersfield, are transferring their East Parade Pattern Works to Lockwood, where new shops covering an area of 14,000 square feet are being erected alongside their foundry and gear works.

CONSIDERABLE extensions are in progress at Messrs. Austin Hopkinson's Delta Works, Guide Bridge, Manchester. New offices have been erected in South Hanover Street, mess room and lavatory accommodation is being provided for the workmen, and an addition made to the erecting shop which will practically double its output capacity.

THE trustee of the sequestrated estates of James Allan, Sen., & Son, ironfounders, Elmbank Foundry, Glasgow, and H. W. Allan and J. T. Twist, the individual partners, intimates that on June 10 he will pay an equalising and fourth and final dividend on the company's estate, and an equalising and final dividend on the estate of H. W. Allan.

ALFRED HICKMAN, LIMITED, of the Springvale Furnaces and Staffordshire Steel and Ingot Iron Works, Bilston, have placed a repeat order with the Premier Gas Engine Company, Limited, of Sandiacre, near Nottingham, for another large gas blowing engine of similar type to that which has now been running at their works for more than two years past

MESSRS. GEO. BRADSHAW & COMPANY, metal merchants, 64, Cross Street, Manchester, have taken over the agency for the sale of the hematite pig-iron made by the Carlton Iron Company, Limited, Ferryhill, Durham. This iron will be branded "Redmarshall," and Messrs. Bradshaw will sell it in the Lancashire district jointly with the hematite iron produced by the Seaton Carew Iron Company, Limited.

THE BRYMBO STEEL COMPANY, LIMITED, of the Brymbo Steel Works, near Wrexham, are installing a refrigerating plant for desiccating the air required for the iron blast and steel furnaces. One of the special features of this installation is that it will be principally worked by the exhaust steam of the blowing engine. The plant is being supplied by Ransomes & Rapier, Limited, of Ipswich, and 32, Victoria Street, Westminster, London, S.W.

THE shareholders of the Pyle and Blaina Works, Limited, have received from the directors a circular outlining a draft scheme for the reconstruction of the company. The main proposal is that a new company should be registered under the title of the Blaina Ferro-Manganese Company, Limited, to be formed with a nominal share capital of £120,000, and a debenture capital of £50,000 in 5 per cent. debentures to acquire the whole undertaking and assets of the company.

A PROPOSAL is under the consideration of the Glasgow iron trade that warrants should be issued and made saleable for 100 tons of pig-iron, and the present practice of issuing warrants for not less than 500 tons discontinued. It is argued that such a change would greatly facilitate business, not merely in a speculative sense, but would make it much easier for small consumers to cover their requirements than it is at present. It is also proposed that Scotch hematite pig-iron should be sold by warrants.

MESSRS. LONGDEN & COMPANY, of the Phœnix Foundry, Furnace Hill, Sheffield, are about to transfer their business to the Carron Company. The business of Messrs. Longden & Company was founded by the grandfather of the present proprietors, and the name of the firm is known the world over for art work in iron and brass. In 1796 Mr. Henry Longden was head of the firm of Messrs. Longden, Newton & Chambers. In 1793 the Phœnix Foundry had been erected, and here the business now known as Newton, Chambers & Company, was carried on until it was removed to Thorncliffe. For

succeeding generations Messrs. Longden have owned the Phœnix Foundry.

THE Martyn Tempered Grit Company, Limited, has been formed with a capital of £10,000, to acquire the chain works at Chapel Street, Airdrie, and to carry on the business of ironfounders, iron manufacturers, and iron merchants. The grit will be manufactured under the patents granted to Mr. Peter Martyn, of the firm of Martyn Bros., engineers and ironfounders. By an ingenious machine the molten metal is directed into a trough of water, and for the resulting grit is claimed the property of uniform hardness as well as control over the sizes to be manufactured. After having been chilled, the grit is taken to a patent drier where the moisture is thoroughly extracted, and it is then conveyed through different conveyors where the various grits are mechanically separated and run into their several hoppers. From the melting of the metal to the packing of the patent grit into bags, the whole operation is mechanical. The new works will be under the management of Mr. William Martyn, brother of the patentee.

THE BOARD OF TRADE have issued printed regulations made under the Trades Board Act, which provide that "When a Trade Board proposes to fix, cancel or vary a minimum rate of wages for time work, or a general minimum rate of wages for piece work in a particular trade it shall (*a*) Send a notice to all employers of labour engaged in the particular trade, so far as their names and addresses are known to the Trade Board, setting out the rate proposed to be fixed and requiring objections to be lodged with the Trade Board within three months, and shall also (*b*) insert a statement of their intention to fix such rate in 'The Gazette,' intimating that on application made to the Trade Board information will (if in the opinion of the Trade Board the applicant is a person likely to be affected by such rate) be given as to the rate proposed to be fixed, and that objections can be lodged with the Trade Board within the time specified in the statement aforesaid. Occupiers of a factory or workshop or of any place used for giving out-work to out-workers are obliged to exhibit copies of the regulations in such a manner as to ensure that notice shall be brought to the knowledge of all workers."

New Companies.

WARRINGTON STEEL FOUNDRY, LIMITED.—Capital £11,000 in £1 shares (10,000 preference).

F. JOHNSON & COMPANY (HULL), LIMITED.—Capital £1,000 in £1 shares, to carry on the business of machinery manufacturers and merchants, engineers, etc.

ALEXANDER CHAPLIN & COMPANY, LIMITED.—Capital £10,000 in £1 shares, to acquire and carry on the business of engineers and crane makers, Helen Street, Govan.

BRITISH ARC WELDING COMPANY, LIMITED.—Capital £15,000 in £10 shares, to carry on business as welders, marine engineers, etc. Registered office: Suffolk House, Laurence Pountney Hill, E.C.

HARRY MASON, LIMITED.—Capital £2,000 in £1 shares, to carry on the business of manufacturers of bar and shop fittings, general brassfounders, etc. Registered office: 62, Dale End, Birmingham.

KANE BROTHERS, LIMITED.—Capital £10,000 in £10 shares, to acquire the business of ironfounders, etc., carried on at Ballymena, Co. Antrim, as Kane Brothers. Registered office: Ballymena Foundry, Ballymena, Co. Antrim.

HILL & HARRINGTON, LIMITED.—Capital £2,000 in £1 shares, to take over the business carried on at 41, Berners Street, W., as Hill & Harrington, and to carry on the business of electrical and mechanical engineers, etc. Registered office: 41, Berners Street, W.

MACHINE SALES, LIMITED.—Capital £2,200 in 2,000 "A" shares of £1 each and 4,000 "B" shares of 1s. each, to carry on the business of manufacturers of and dealers in agricultural implements and other machinery, etc. Registered office: 19, Old Queen Street, Westminster, S.W.

NEW PHOSPHOR BRONZE COMPANY, LIMITED.—Capital £100,000 in £1 shares, to carry on the business of manufacturers of and dealers in non-ferrous metals and metallic compounds and alloys, etc., and to adopt an agreement with W. Lester. Registered office: St. Leonards Road, South Bromley, E.

E. D. MONKS & SON, LIMITED.—Capital £2,500 in £1 shares (1,250 preference), to acquire and take over as a going concern the business of file-cutters and general mechanical engineers, now carried on by E. D. Monks & Son, at Redditch, Worcester, etc. Registered office: 14, Church Green East, Redditch, Worcester.

DUMBARTON WELDLESS TUBE COMPANY, LIMITED.—Capital £100,000 in £1 shares (36,000 preference and 64,000 ordinary), to enter into an agreement with Kosmoid Tubes, Limited (in liquidation), and to carry on the business of manufacturers of steel, iron and copper tubes, etc. Registered office: Dumbuck Works, Glasgow Road, Dumbarton.

THOMAS SANDERS, LIMITED.—Capital £50,000 in 3,000 preference shares of £5 each and 35,000 ordinary shares of £1 each, to take over the business of builders' brassfounders, etc., carried on by H. W. Sanders, T. Sanders, and G. Sanders at the St. Mary Street Brassfoundry, St. Mary Street, Ladywood, Birmingham, as Thomas Sanders. Registered office: St. Mary Street Brassfoundry, Ladywood, Birmingham.

DRABBLE, GREENWOOD & COMPANY, LIMITED.—Capital £5,000 in £1 shares, to take over the business of fluorspar, barytes, calcite, limestone, zinc, and lead ore merchants, and miners carried on by G. C. Drabble and E. P. Drabble at Matlock and elsewhere in Derbyshire, as Drabble Brothers, together with the mining rights, mines and property referred to in an agreement between the vendors and R. Greenwood, D. H. Greenwood, and B. O'Dowda.

Deaths.

COLONEL J. E. CUTLER, a director of William Jessop & Sons, Limited, Sheffield, died recently.

MR. R. FLETCHER, of Newcastle-on-Tyne, who until a couple of years ago owned the Low Walker Forge and St. Peter's Forge, died recently.

MR. J. DUNGATE, of Messrs. J. Dungate & Sons, agricultural and general engineers, Pluckley, near Ashford (Kent), died recently, aged 79 years.

MR. J. H. CONVERSE, president of the Baldwin Locomotive Works, Philadelphia, died at his home at Rosemount, Pa., on May 3, aged 69 years.

MR. J. PILLING, manager of the engineering department of the business of Messrs. Howard & Bullough, Globe Iron Works, Accrington, died recently, aged 63 years.

THE death occurred recently at Warminster, Wilts., of Mr. John Wallis Titt, head of the well-known agricultural implement firm who own the Woodstock Iron Works, Warminster.

THE death is announced of Mr. A. S. Hay, chairman of Naylor, Benzon & Company, Limited, 20, Abchurch Lane, London, E.C. and a director of Dorman, Long & Company, Limited, Bell Bros., Limited, and the North-Eastern Steel Company, Limited. The deceased gentleman was 70 years of age.

MR. WILLIAM RUSSELL, of the Omoa Boiler Works, Cleland, died last month of heart failure, aged 61 years. The deceased was associated with his father in starting the Omoa Boiler Works nearly forty years ago. The firm built up a large business, and executed many large contracts, especially for tubing in connection with gas convevance at blast furnaces. The deceased had practically retired from business.

MR. JOHN JOHNSTON, one of the oldest ironfounders in Scotland, died at Edinburgh recently, aged 80 years. The deceased began business as an ironfoun-

(*Continued on page* 328.)

COMPLETE
Foundry Equipment.
Telegrams: "LADLES" MANCHESTER
Telephone: "No 2297 CENTRAL" MANCHESTER.

JAMES EVANS & Co. BRITANNIA WORKS, BLACKFRIARS, MANCHESTER.

der at Beaverbank, Edinburgh, along with the late Mr. Samuel Boyce, many years ago, and the firm continued in business for close on 40 years. The deceased was widely known in the ironfounding trade throughout Scotland, and was much respected. He took no active part in public affairs.

Mr. R. B. Tennent, founder of the Whifflet Iron and Steel Foundry, Coatbridge, died at Bothwell, on April 29. The deceased was eighty-one years of age, and had been in declining health for some time. After carrying on business for some time as a moulder on his own account, he founded in 1870 the Whifflet Foundry, which under the style of R. B. Tennent, Limited, has grown to be one of the largest concerns of its kind in the Kingdom.

Personal.

Mr. Corey, the president of the United States Steel Corporation, is making his annual visit to Europe.

Mr. George Senior, of George Senior & Sons, Limited, Sheffield, will be the next Master Cutler of Sheffield.

The late Sir Frederick Thorpe Mappin, Bart., of Thornbury, Sheffield, left estate of the gross value of £931,086.

Mr. R. F. Taylor, of Taylor, Law & Company, Limited, Anchor Works, Adams Street, Birmingham, has sailed for the West Indies.

Mr. Benjamin Talbot, managing director of the Cargo Fleet Iron and Steel Company, Limited, has returned from the United States.

The gross value of the estate left by the late Mr. T. C. Willey, of Messrs. John Willey & Sons, steel manufacturers, Sheffield, is £11,503.

Mr. Wm. Russell, vice-chairman of Fletcher, Russell & Company, Limited, has resigned his position on the board. Mr. J. Neil is no longer a director of the company.

Mr. R. B. Robinson, foundry manager to the Campbell Gas Engine Company, Limited, has been appointed to a similar position by Robey & Company, Limited, Lincoln.

The late Mr. George Whale, late chief mechanical engineer of the London and North-Western Railway Company, left estate of the gross value of £15,628, with net personalty £15,364.

The late Mr. James Hornsby, J.P., of Laxton Park, Northants, a director of Richard Hornsby & Sons (Limited), Grantham, left estate valued at £112,978 gross, with net personalty £69,267.

Mr. F. C. Fairholme, of Thomas Firth & Sons, Limited, Sheffield, has been appointed as a member of the committee of the International Association which has the question of definitions in hand.

Mr. P. W. Robson, formerly with the National Gas Engine Company, Limited, at Ashton-under-Lyne, has been appointed as the general manager of the Lincoln works of Clayton & Shuttleworth, Limited.

The late Mr. Henry Pinnell, of Church Road, Edgbaston, Birmingham, J.P., managing director of Wm. Whitehouse & Company, Limited, brass founders, left estate valued at £26,493 gross, with net personalty £23,975.

Mr. A. B. Coull, M.I.N.A., consulting engineer, etc., Baltic Chambers, 79, Quayside, Newcastle-on-Tyne, has taken into partnership, as from April 1, Mr. W. Dodds and Mr. T. B. Coull, who have for some years past assisted him in his business.

Mr. Alfred Campion is resigning the Secretaryship of the West of Scotland Iron and Steel Institute, having been appointed to succeed Prof. Sexton. Mr. Herdsman, formerly connected with Mr. Edward Riley's firm, will continue Mr. Campion's analytical and consulting practice.

The Council of the International Association for Testing Materials have nominated Mr. Henry M. Howe, Professor at the Columbia University in New York, acting president of the Association, in the place of the late Dr. Charles B. Dudley. Professor Henry M. Howe has consented to undertake the office.

The Governors of the new constituted School of Metalliferous Mining (Cornwall), have appointed Mr. W. Fischer Wilkinson as Principal. Mr. J. J. Beringer, who has been for 28 years Principal of the Camborne Mining School, will join the staff of the new school, taking charge of the metallurgical subjects.

Mr. J. E. Sears, A.M.I.C.E., has been appointed by the executive committee of the National Physical Laboratory to take charge of the work of the Metrology Division of the Laboratory, in succession to Mr. H. Jeffcott, who has been appointed to the professorship of engineering in the Royal College of Science, Dublin.

Mr. Thomas W. How, of 15, Victoria Street, Westminster (the managing director of the Empire Roller Bearings Company, Limited), has been appointed managing and consulting director of the Horsfall Destructor Company, of Pershore, in succession to the late Mr. Arthur Greenwood. The business of both companies will be directed from the above London address.

Mr. Thomas Barningham, The Limes, Eccles Old Road, Pendleton, has been made a J.P. for the City of Manchester. Mr. Barningham is a nephew of the late Mr. William Barningham, who in the fifties carried on an extensive ironworks in the premises in Frederick Road now used by the Steel Journal Box Company, Limited, and an engineering works in Withington Street, Pendleton. Mr. Barningham subsequently erected at Darlington an iron and steel works, which are now dismantled.

The employés of the foundry department of the Campbell Gas Engine Company, Limited, met at the West End Hotel, Halifax, recently, to make a presentation to Mr. R. B. Robinson, the foundry manager, who was leaving to take up a similar position at the works of Robey & Company, Limited, Lincoln. Mr. Robinson was also the recipient of presentations from the general staff and the students at the Halifax Technical School. He will be succeeded by Mr. J. G. Robinson, who has been for three years manager of the Butterley Company's Foundry.

Mr. T. P. Barker, general manager of Ashmore, Benson, Pease & Company, Limited, constructional engineers, etc., Stockton-on-Tees, has resigned his position to become managing director of Thomas Piggott & Sons, Limited, Birmingham, and recently was the recipient of a very handsome present, consisting of a collection of fine old Sheffield plate, from the officials and workmen. Mr. Wilfrid Beswick, secretary to the company, and also secretary to the Power Gas Corporation, Limited, has been appointed general manager in the place of Mr. Barker, and Mr. R. B. Hodgson, late works manager, has been appointed engineering manager.

Mr. Walter Macfarlane, F.I.C., the newly-elected president of the Staffordshire Iron and Steel Institute, was born near Glasgow, and received his general and business training in that city. Relinquishing a business career he entered Anderson's University (now the Glasgow Technical College) and applied himself to the study of chemistry and other sciences, subsequently being awarded the Stevenson Bursary in Technical Chemistry, which he held for three years. For nearly six years he was engaged in the Monk Bridge Iron Works, Leeds, and for several years he was chief chemist to Merry & Cunninghame, Limited, and the Glengarnock Iron and Steel Company, Limited. While there he carried out extensive investigations concerning blast-furnace and other gases. Thoroughly acquainted with the various iron ores, etc., and with blast-furnace practice, he was the responsible adviser with regard to furnace burdens, and also for steel mixtures. Latterly he had the management of the Siemens' Steel Department. He was Assessor on Metallurgy at the Glasgow Technical College. Since 1896 he has been Principal of the Staffordshire Metallurgical Classes.

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From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, mor free from blowholes and other defects, than we formerly did.

From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using your Foundry Coke for several years for special purposes with highly satisfactory results.

Elders Navigation Collieries, Ltd., Cardiff.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years:—

METALS.	End May, 1910.	End May, 1909.
Iron—Scotch pig warrants ton	*55/10½	*53/9
—Middlesbro' warrants ... ton	49/11	48 0
—W.C. Mines Bessemer ... ton	68 0	58 9
—Stock, Scotch ... ..tons	1,060	1,000
Copper—Chili bars, GMB ton	£76 7 6	£59 17/6
—Stock, Europe and afloat tons	—	57,444
Tin—English ingots ... ton	...£149 0 0	£132 10/0
—Straits ... ... ton	£150 5 0	£132 2/6
—Stock, London, Holland, U.S.A., and afloat ...tons	—	18,924
Lead—English pig ... ton	£13 0 0	£13 15 0
Spelter—Ord. Silesian ... ton	£22 1 3	£22 2 6
Quicksilver (75lb)... bottle	£8 15 0	£8 7 6
Antimony—Regulus ... ton	£30 0/0—£30 10/0	£33 0 0—£34 0/0

* Settlement price.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings:—

	£ s. d.		£ s. d.
Columns (plain)	5 10 0	to	6 15 0
Pipes, 1¼ to 2¼ in.	4 17 6	to	5 2 6
,, 3 to 4 in.	4 10 0	to	5 0 0
,, 5 to 8 in.	4 7 6	to	4 10 0
,, 10 to 16 in.	4 7 6	to	4 10 0
,, 18 to 24 in.	4 7 6	to	4 10 0
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	3 2 6	to	3 5 0

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows:—Heavy wrought (mixed), £2 9s. 0d.; light wrought, £1 7s. 6d.; heavy cast, £2 10s. 0d.; all per ton f.o.b., London. Copper (clean), £54 0s. 0d.; brass (clean), £39 0s. 0d.; lead (usual draft), £12 0s. 0d.; tea lead, £11 0s. 0d.; zinc, £17 10s. 0d.; all per ton delivered merchant's yard.

To meet the constantly increasing demand in America for their Stag brand of manganese steel products, and particularly for railway points and crossings, Edgar Allen & Company, Limited, Imperial Steel Works, Sheffield, are at present engaged in the erection and equipment of an extensive plant at Chicago, Ill., for the manufacture of their specialities. This branch of the Sheffield concern has been incorporated at Springfield, Ill., under the name of the Edgar Allen Manganese Steel Company, with a capital of $300,000.

Legal.

Sand with Pig-iron.

A case of some considerable interest was heard at Newcastle County Court, recently, when Messrs. Scott Bros. sued the Hindustan Steam Shipping Company for moneys retained, and a counter-claim was set up to retain some of the money under charter, the point at issue being whether Messrs. Scott should pay for sand carried with pig-iron.

Edmund Senior, master of the s.s. "Kurdistan," estimated that in a cargo of pig-iron from Middlesbrough he carried 25 to 30 tons of sand adhering to pig-iron. The bills of lading did not take account of the sand. After the iron was discharged the sand had to be cleared out, and its presence necessitated his shipping extra bunker coal in the Mediterranean at higher prices than he would have paid on the Tees.

Mr. Ingledew argued for Messrs. Scott that the charterers' liability ceased on the bills of lading being signed, and if they were not correct the master should have refused to sign them.

His Honour Judge Greenwell gave judgment for defendants, and said the question was whether the shipowner should be forced to carry 30 tons of sand or anything else adhering to pig-iron without being paid for it, because the charterer did not get paid for it by the consignee. As a business question between business men they could not make the shipowner carry more tonnage than they were going to pay for without expressly stipulating it.

Mr. Ingledew said the question was an important one of principle, and he asked leave to appeal.

This was granted.

A Cargo of Ferro-Silicon.

In the Court of Appeal, last month, Lords Justices Vaughan-Williams, Fletcher Moulton, and Farwell delivered their reserved judgment in the case of Frances Bamfield *v.* the Goole and Sheffield Transport Company, Limited, which raised a question of considerable importance to shippers and others. The appeal was by the defendants, from a judgment of Mr. Justice Walton, at the Leeds Assizes. Lord Justice Vaughan-Williams, in giving judgment, said he had come to the conclusion that the appeal must be dismissed on the ground that the defendants owed a duty to Bamfield to communicate such information as they had as to the nature of the goods to be sent in the barge, and that through their servants they were guilty of negligence and want of care in not communicating to the carrier the name, which they knew, of this somewhat unusual cargo. The measure of damages was the same whether it was implied warranty or negligence. In his judgment, when a consignor shipped goods without warning as to their dangerous character, he thereby impliedly warranted to the carrier that the goods were fit to be carried, and were not dangerous.

Lords Justices Moulton and Farwell delivered judgment to the same effect.

The appeal was accordingly dismissed with costs.

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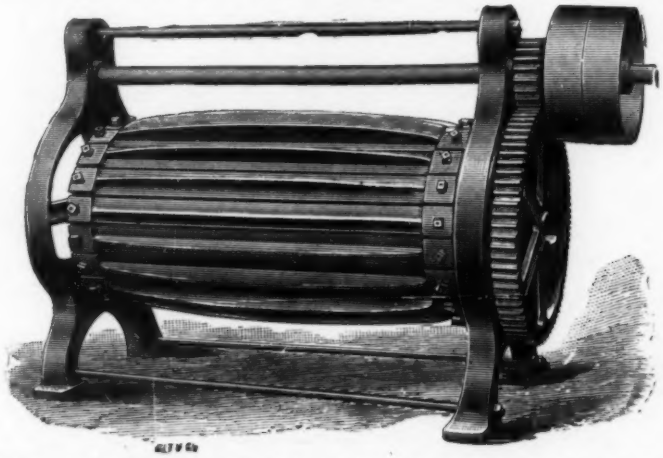

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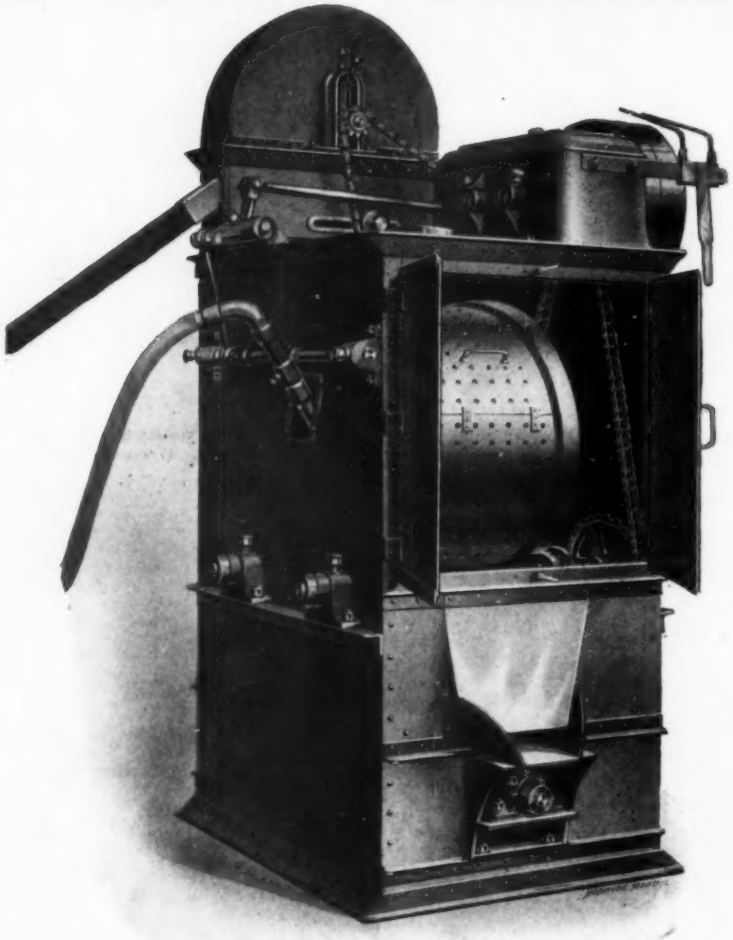

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Evans, J., & Co.
Hall, Charles, & Co.
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Olsen, Wm.
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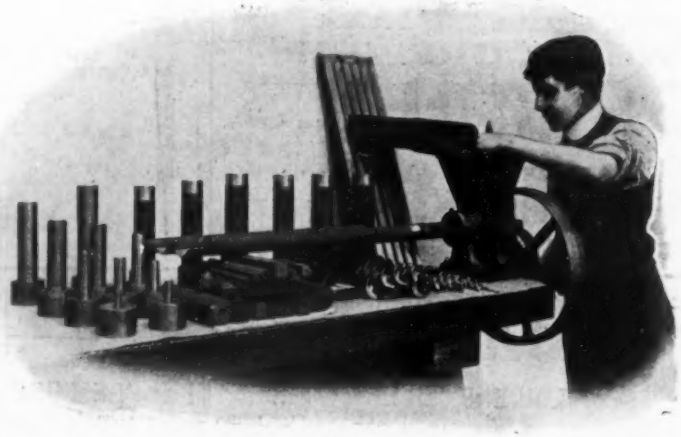

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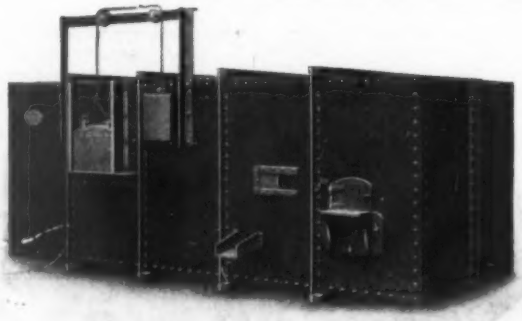

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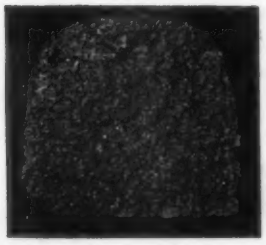
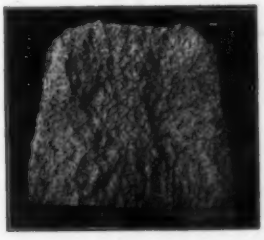
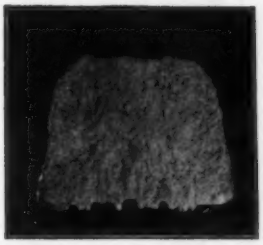

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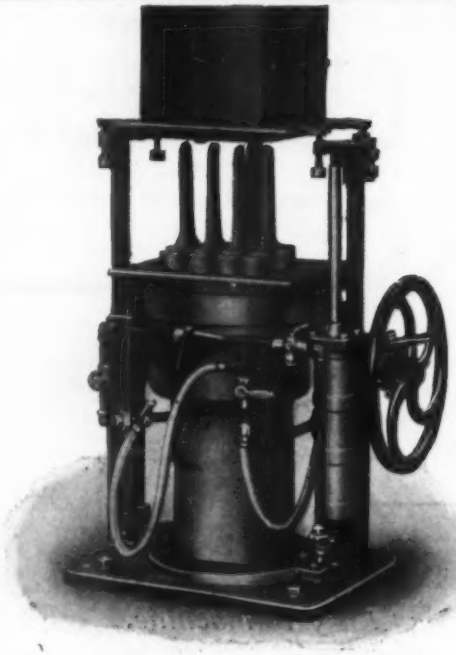

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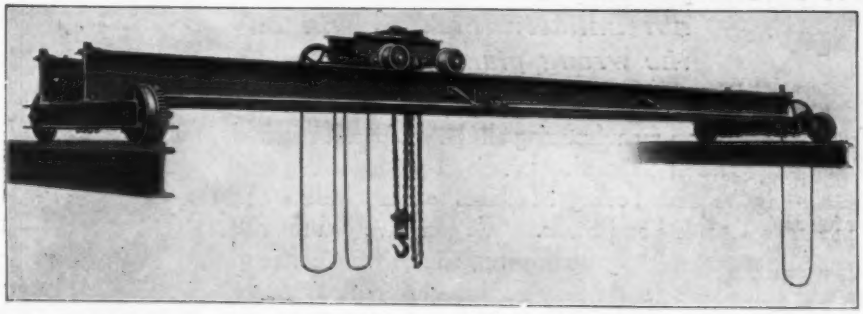

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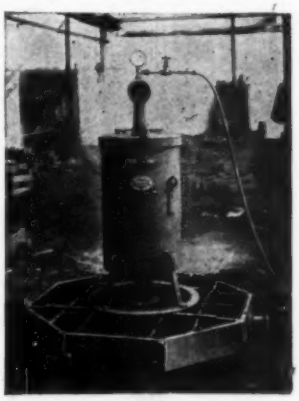

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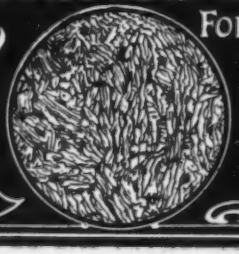

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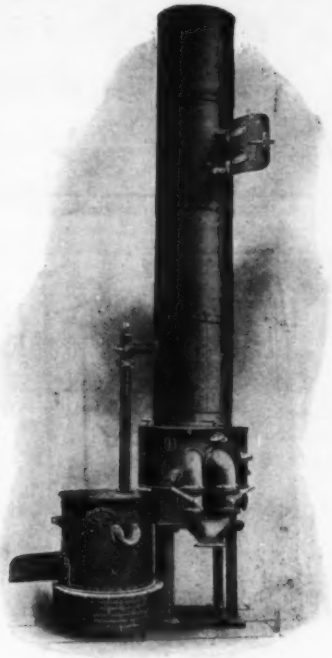

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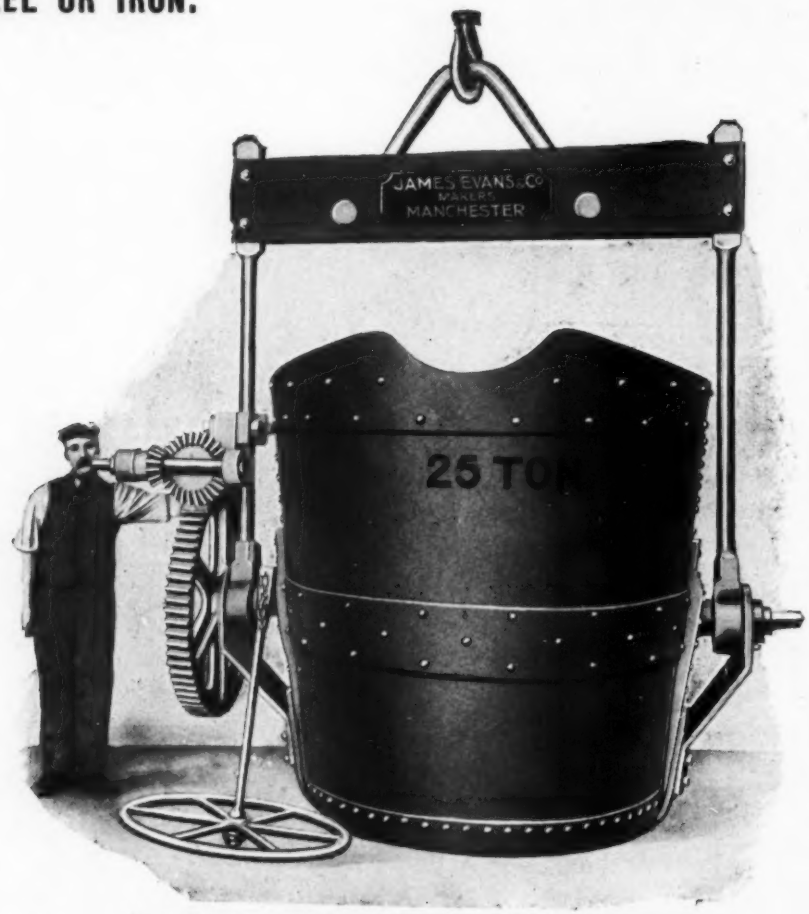

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